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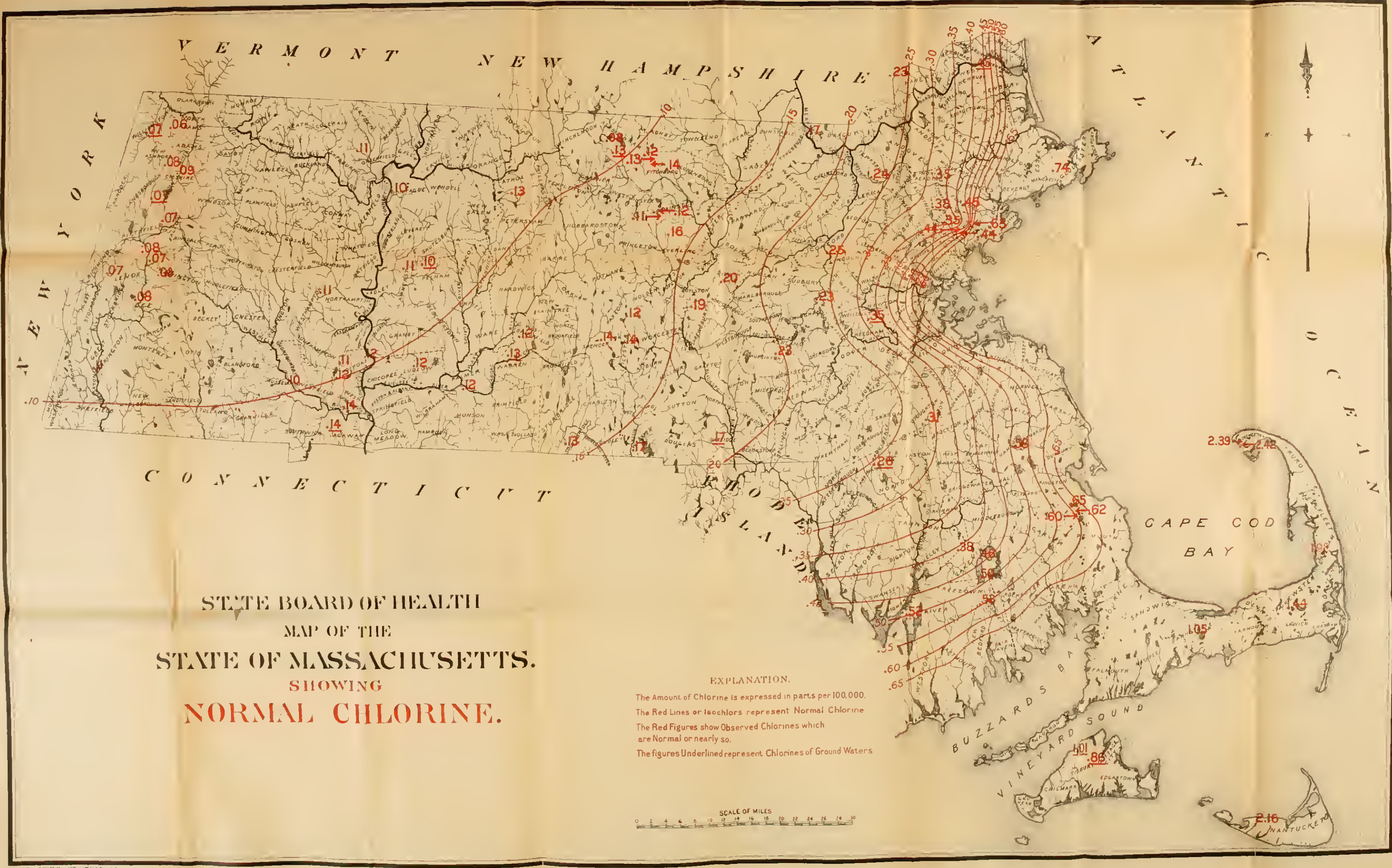

STATE BOARD OF HEALTH

MAP OF THE

STATE OF MASSACHUSETTS.

SHOWING

NORMAL CHLORINE.

EXPLANATION.

The Amount of Chlorine is expressed in parts per 100,000.

The Red Lines or Isochlors represent Normal Chlorine

The Red Figures show Observed Chlorines which are Normal or nearly so.

The figures Underlined represent Chlorines of Ground Waters

HELIOTYPE PRINTING CO

PUBLIC DOCUMENT. . . . . . No. 34.

TWENTY-SECOND ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
1891.

MEMBERS OF THE BOARD.

1890–91.

HENRY P. WALCOTT, M.D., *Chairman*,	of Cambridge.
FRANK W. DRAPER, M.D.,	of Boston.
HIRAM F. MILLS, C.E.,	of Lawrence.
ELIJAH U. JONES, M.D.,	of Taunton.
JULIUS H. APPLETON,	of Springfield.
JOSEPH W. HASTINGS, M.D.,	of Warren.
JOHN M. RAYMOND,	of Salem.

Secretary.
SAMUEL W. ABBOTT, M.D.

Chief Engineer.
FREDERIC P. STEARNS.

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GENERAL REPORT.

The following report comprises the general work of the State Board of Health for the year ending Sept. 30, 1890, together with certain papers upon special topics of sanitary importance.

The report embraces the following subjects: —

REPORT TO THE LEGISLATURE UPON WATER SUPPLY AND SEWERAGE, EMBRACING THE ADVICE OF THE BOARD GIVEN UNDER THE AUTHORITY OF CHAPTER 375 OF THE ACTS OF 1888.

EXAMINATIONS OF WATER SUPPLIES AND RIVERS FROM JUNE 1, 1889, TO DEC. 31, 1890.

SUGGESTIONS AS TO THE SELECTION OF SOURCES OF WATER SUPPLY, BY F. P. STEARNS, C.E., CHIEF ENGINEER OF THE BOARD.

REPORT ON FOOD AND DRUG INSPECTION.

SUMMARY OF WEEKLY MORTALITY REPORTS.

PAPER UPON GROWTH OF CHILDREN, BY PROFESSOR H. P. BOWDITCH.

TYPHOID FEVER IN ITS RELATION TO WATER SUPPLIES, BY H. F. MILLS, C.E.

THE HEALTH OF TOWNS.

The following members comprised the Board in 1890: —

HENRY P. WALCOTT, *Chairman.*

HIRAM F. MILLS,	ELIJAH U. JONES,
FRANK W. DRAPER,	JOSEPH W. HASTINGS,
JULIUS H. APPLETON,	JOHN M. RAYMOND.

THEODORE C. BATES resigned in November, 1889, and JOSEPH W. HASTINGS of Warren was appointed to fill the vacancy.

The term of office of Thornton K. Lothrop expired in June, 1890, and John M. Raymond of Salem was appointed to fill the vacancy.

At the annual meeting held in June, 1890, the following officers were chosen: —

Chairman, ...	Henry P. Walcott.
Secretary, ...	Samuel W. Abbott.

Under the provisions of chapter 375 of the Acts of 1888, Frederic P. Stearns was reappointed as the engineer of the Board and Joseph P. Davis as its consulting engineer.

The following standing committees were also chosen: —

Finance. — Messrs. Appleton, Walcott and Hastings.

Publications. — Messrs. Walcott, Appleton and Draper.

Water Supply and Sewerage. — Messrs. Mills, Walcott, Draper, Jones and Raymond.

Public Institutions. — Messrs. Walcott, Mills, Jones and Draper.

Legislation and Legal Proceedings. — Messrs. Appleton, Hastings and Raymond.

Health of Towns and Correspondence with Local Boards of Health. — Messrs. Draper, Mills and Hastings.

Contagious Diseases. — Messrs. Jones, Walcott and Draper.

Registration of Vital Statistics. — Messrs. Draper, Walcott and Jones.

Contagious Diseases.

The year 1890 was unusually free from severe outbreaks of contagious disease. The only noteworthy epidemic was that of influenza, which began in December, 1889, and ended in February, 1890, and was made the subject of a special investigation and report in the last annual report.

Small-pox.

The total number of cases of small-pox which were reported to the Board during the year was only six, of which one only was fatal. The cases were limited to four families, and the particulars relative to these cases are detailed in the following table: —

Record of Cases of Small-pox reported to the State Board of Health in 1890, under the Provisions of Chapter 138 of the Acts of 1883.

Number.	Place of Occurrence.	Date of Report.	Nationality.	Age.	Sex.	Deaths.	Occupation.	Previously Vaccinated.	Number of Scars.
[1] 1	G't Barrington,	Feb. 17,	Irish,	24 yrs.	M.	-	Operative,	Yes.	1
[2] 2	G't Barrington,	Mar. 2,	Irish,	20 "	F.	-	Operative in woollen mill.	Yes.	-
[3] 3	Huntington,	April 15,	Fr. Canadian,	3 "	F.	-	- -	No.	-
[3] 4	Huntington,	April 15,	Fr. Canadian,	1 "	M.	-	- -	No.	-
[4] 5	Boston,	May 9,	United States,	52 "	M.	-	Teamster.	-	-
[5] 6	Chelsea,	-	- -	18 "	F.	1	- -	-	-

[1] Contracted in Meriden, Conn.; vaccinated at age of three years.

[2] Sister of No. 1; vaccinated February 21.

[3] Father and two aunts worked in paper mill in which both foreign and domestic rags were used.

[4] Doubtful; no scar to be seen.

[5] Date of death June 9, 1890.

The total number of deaths in Massachusetts from this cause for the past ten years has been as follows: —

Years.	Deaths.	Years.	Deaths.
1881,	47	1887,	3
1882,	45	1888,	9
1883,	5	1889,	6
1884,	3	1890,	1
1885,	19		
1886,	1	Total, ten years,	139

Notice of the occurrence of cases of small-pox was also received from the public health authorities of the following States and provinces, these notices having been sent in compliance with the resolutions adopted by the International Conference of Boards of Health at Toronto, Oct. 6, 1886.

Connecticut. — Two cases at Windsor, January, 1890. In these cases it was stated that the disease was contracted by riding in a hack in which a previous patient ill with small-pox had been conveyed to hospital. Four cases also at Windsor in January, contracted by persons working in the rag-room of a paper mill. Seven cases at Meriden, February 14, origin unknown. (The Great Barrington cases, reported above, originated at Meriden, Conn.) Nineteen cases at Meriden, April 1, contracted from previous cases.

Michigan. — One case at Grand Rapids, February 12; laborer; origin of disease unknown. One case at Big Rapids, February 20; origin unknown.

Province of Quebec. — One case, November 15, at Grosse Isle; an immigrant. One case, July 5, at Grosse Isle; origin unknown. One case, July 14, at Grosse Isle; origin unknown.

Kansas. — One case at Topeka, April 10; origin unknown.

Maine. — One case at Searsport, June 6; origin unknown; came from Porto Rico. Three cases at Searsport, June 25, contracted from previous case. One case at Searsport, June 17, contracted from previous case.

Other Infectious Diseases.

Two cases of leprosy were reported as existing in Pennsylvania; one reported from Philadelphia, April 1, 1890, a Chinese immigrant; the other reported November 1, from Chester, a Swede; had been a resident of Chester three years.

In addition to these, six cases of typhus fever were reported by the State Board of Health of New York, Jan. 6, 1890. They had arrived on a steamer from Antwerp during December.

Diphtheria.

The attention of the Board having been called to the following cases by the local boards of health of certain towns, special inquiries were made, as follows: —

A Report on Four Cases of Diphtheria in Montgomery.

At the request of Dr. Abbott I went on May 13, 1890, to Huntington to see some cases of diphtheria under the care of Dr. W. G. Kimball. Dr. Kimball drove me to Montgomery, a town situated away from any railroad, some one thousand feet above the sea level. In Montgomery, on a cross street, fully one-quarter of a mile from the nearest house, is a deserted farm which is occupied by a family in destitute circumstances. The house is much dilapidated, and in one room, used also as a kitchen and supplied with a sink, lived father, mother, four children and a servant. In April, the father and mother went to Westfield to take care of two older children who had diphtheria in that town. The girls lived in Westfield and worked in a tobacco factory. Soon after the return of the parents diphtheria appeared in the children at home. Four children have since had diphtheria; a girl of fifteen, who has been sick two weeks; a girl of eleven, who has been sick one week; a boy of five, and a younger child, who died within a few days, of laryngeal obstruction. The fatal case was the only one in which there has been diphtheria of the larynx. In the other cases there was extensive exudation on the pharynx, fauces and roof of the mouth; in all the cases there was a foul, bloody discharge from the nose; in all the cases vomiting and diarrhœa.

At the time of my visit the boy was pale, had a small and thready pulse, temperature elevated; both nostrils occluded by foul, blackish crusts; lips ulcerated and black; sordes on teeth; tongue dry and cracked. He had had constant vomiting for several days.

Girl, fifteen years; pale, emaciated, with a waxy appearance and a yellowish tinge of the skin; nose, lips and teeth as in the boy; pulse small and feeble. Looked very sick and like a person suffering from severe septic poisoning.

Girl, eleven years; not as sick as the preceding girl, but nose and mouth in a similar condition.

The house was very dirty, the people poor and extremely heedless. In spite of the great devotion of the attending physician, and his earnest request to the contrary, the family disregarded all his orders and used the same cloths to clean the patients and wipe up the kitchen utensils. All the patients, father, mother and an attendant, were in one small room. In a kitchen stove was a large fire; in the corner a sink; three beds, a sofa and one chair almost filled the rest of the room.

It seems evident that the disease was brought to the children by the parents, who attended the daughters sick with diphtheria in Westfield. The child that died was buried by the physician and the undertaker on the morning after its death.

These cases all belong to the most virulent type of diphtheria, and all were attended by severe septicæmia.

As the house is almost worthless Dr. Kimball proposes to burn the house and contents after the disease has run its course. To indorse him in this view he asked the co-operation of the State Board of Health.

On June 21 I received from Dr. Kimball a letter reporting that all the cases seen with him on May 13 have since died. One of the older girls died in Westfield; all four who lived in Montgomery died; the first died of laryngeal obstruction on the fifth day, the others on the fourteenth, seventeenth, and twenty-third days respectively. No other cases have appeared since in Montgomery or Huntington.

Respectfully submitted to the State Board of Health,

HENRY JACKSON.

JUNE 23, 1890.

An Epidemic of Diphtheria at Easthampton, Hampshire County, Massachusetts.

Easthampton is situated on the river Manhan, three miles from the Connecticut River and about one and a half miles from the foot of Mount Tom. The chief part of the town is on a small plateau some hundred feet above the bed of the Manhan. South of the centre of the town are two large ponds which are utilized for manufacturing purposes. Between the ponds and Mount Tom is a plateau which slopes gradually down to the pond; across this plateau runs a ravine from south to north, in which there is a small stream which empties into the lower mill-pond. A part of the plateau slopes towards the south or upper mill-pond, another part towards the ravine mentioned above, while the northerly portion drains into the lower mill-pond. These ponds finally empty into an arm of the Connecticut River, which in past times formed the chief bed of that river.

These ponds are dammed, and in dry weather the flow of water is so slight that the manufactories on the banks are obliged to use steam. Throughout the town the surface soil is dry, composed of sand or gravel, and some three feet below the surface is a layer of clay.

The town receives its water from three sources: first, a pond some two miles west of the town and now rarely used; second, from a reservoir situated on Mount Tom supplied naturally from springs in its immediate neighborhood. This reservoir has been in use for about a year and furnishes a water of good quality, as determined by chemical analysis. In the centre of the town there are sewers; one empties into the Manhan, which is shallow but has a swift current even in dry weather; the opening of the sewer is so situated that it is not exposed at any time. Another part of the town is supplied with sewers which empty into the lower mill-pond. A very small part of the plateau towards Mount Tom is drained by a sewer which empties into the upper mill-pond. Since the outbreak of diphtheria, in June, a sewer has been built which will drain a large part of the most thickly settled part of the plateau. The ravine above mentioned would afford a natural bed for a sewer which would drain to the greatest advantage the remaining section of the plateau.

The town is situated on a branch of the Connecticut River Railroad. There are 4,300 inhabitants. During the last four years an accurate account of infectious disease has been kept, and during that time the mortality has been small and there has been a marked absence of infectious disease, as will be seen by reference to the subjoined table. The only exception to this rule is the occurrence of an epidemic of typhoid fever some years ago in a portion of the town called "the new city," situated some distance from the centre. This epidemic was at the time attributed to the bad hygienic condition of a mill in which most of the inhabitants of the "new city" worked. Extensive changes were at that time made in the mill, and since then there has been no recurrence of typhoid fever.

Cases of Infectious Disease reported to Board of Health, 1885–1890.

YEAR.	Scarlet-fever.	Diphtheria.	Typhoid fever.
1885,	5	1	
1886,	2	–	
1887,	9	2	
1888,	2	1	1
1889,	15	22	1
1890, to June 6,	–	72	–

Two of the cases in 1889 occurred in May and July respectively. As no more cases occurred for six months, until the outbreak of the present epidemic, these cases are not included in this report. The case in July was on the street in which there were the most cases in the epidemic, but further than that there is no evidence to trace the present epidemic to that case.

Present Epidemic.

December 7. — Five cases in one family.

December 20. — Two cases. From this date to May 27, 85 cases were reported. Total, 92 cases in five months; mortality, 28, or 30.4 per cent.

Children, fifteen years or under,	64;	mortality, 37.5 per cent.
Adults,	28;	mortality, 15 per cent.
One year or under,	5;	mortality, 60 per cent.
Thirty-five years or older,	5;	mortality, 20 per cent.

The oldest, sixty-five years, and the youngest, seven months, both recovered.

Of the first 23 cases,	8 died.
Of the second 23 cases,	8 died.
Of the third 23 cases,	4 died.
Of the fourth 23 cases,	8 died.
Total, 92 cases,	28 died.

The above table shows that there was no material change in the virulence of the epidemic during its course.

These 92 cases occurred in 49 families.

In 1 family,	6 cases.
In 2 families,	5 cases.
In 2 families,	4 cases.
In 7 families,	3 cases.
In 9 families,	2 cases.
In hotel,	2 cases.
In 25 families,	1 case.

Sixty cases occurred in a small district on the plateau already mentioned; of these 60 cases 4 were situated at quite a distance from the others, towards Mount Tom. Thirty-one cases occurred on Gough, Pine and Holyoke streets; these streets had no sewer and all the houses have cesspools in the immediate neighborhood of the house, or allow the refuse water to run out upon the surface of the ground. Three cases occurred on Everett Street at a distance from the centre of the town and far from the plateau; it is of interest to note that these cases occurred in a house situated on the border of the ravine above mentioned, which formed a natural drain to a part of the district where a large number of cases occurred. Ten cases occurred at a distance of a mile or more from the centre of the town and from the plateau. This leaves a balance of 22 cases, which were scattered pretty equally through all parts of the town.

Distribution of Cases by Streets.

In district on plateau between the mill ponds and Mount Tom,				60
Everett Street, east from city (near ravine),				3
North Street (1 family), north from centre,				4
Crow Hill,				2
New City,				1
Clark Avenue,	2		Scattered through the central part of the town,	22
Main,	1			
Hotel,	2			
Manhan,	3			
Payson,	1			
Pleasant,	4	Adjoining streets.		
Prospect,	3			
Summer,	1			
Union,	4			
Williston Avenue,	1			
				92

I visited 15 houses, besides the hotel, in which cases of diphtheria appeared. A few of them were connected with the town sewer but their sinks were not separated from the sewer by an efficient trap.

In most of the houses the kitchen sinks were connected with very foul cesspools, and in no case did I find any efficient traps. In many of the houses visited the drain pipes were broken in the cellars, thereby allowing the sewage to run directly upon the floor.

Of the 49 houses where diphtheria appeared 34 were situated on streets in which there was no sewer; 15 houses were situated on the line of a town sewer, and of this number 8 were connected with the sewer and 7 were not. Since the epidemic a sewer has already been laid which passes through a large part of the district where diphtheria prevailed to the greatest extent.

Sewers.

No sewer in street, ...	34 houses.
Sewer in street but no connection, ...	7 houses.
Sewer in street and connected, ...	8 houses.
	49 houses.

Report on Individual Houses.

1. R ——, Holyoke Street; a new house on the further end of the plateau. No sewer. A young woman and a young man who worked in the mill had diphtheria and both recovered. In the yard is a cesspool at some distance from the house; no trap; pipes good. In the sink is a bell trap, which appears to be the favorite form of trap at Easthampton, and in most cases the only one in use. The bell trap is placed in the sink in the place of an ordinary filter and is supposed to prevent the entrance of sewer gas. Near this house are five other new houses, and in one there was a case of diphtheria. All are practically in the same condition as to sewage.

2. T ——, Water Street. The house is at the foot of Water Street, on the border of the upper mill-pond. Eight children in the family; five had diphtheria. In the kitchen is a sink, and a pump which draws water from a well in the cellar. The waste pipe runs down on one side of the cellar wall, under the house, and empties some seventy-five feet from the house on the bank of the upper mill-pond. Into the same pond empties a small sewer, also a new sewer laid on Holyoke Street, and the drainage from all the houses situated on the bank. On the opposite bank is a cemetery. The ice for the town is cut from this pond.

In the cellar of the T —— house the waste pipe is broken in the middle, the lower segment being held in place by a string.

There is a large drain pipe into which the lower end of the soil pipe enters; the opening of the drain pipe is partially closed by rags.

There was at the time of the examination much water and filth on the cellar floor; no trap. It is difficult to imagine a more dangerous condition of affairs when one considers that the well was under this foul cellar floor.

3. House on Water Street. No cases of diphtheria appeared in this family. The drain emptied into a very foul cesspool. The cellar floor was wet and filthy, as the trough leaked badly.

4. N——, Gough Street. Two children had diphtheria. House clean. The kitchen sink was emptied by a short pipe which opened directly out of doors on to a steep bank. In this family clothes from a case of diphtheria were washed.

5. T——, Gough Street. Waste pipe opens directly out of doors and the water runs into a trough, where it accumulates. The examination was made in dry weather, yet there was much water in this trough. When diphtheria appeared in this family the well members of the family went to another house, in which cases of diphtheria appeared six weeks later.

6. L——, Gough Street. Three cases. Waste pipe runs directly into the yard and empties at quite a distance from the house.

7. C——, Everett Street. House situated at a distance from all other houses where diphtheria occurred; this is the house which has been referred to as situated on the ravine which runs down from the plateau. The waste pipe enters the drain pipe in the cellar at a right angle; the end of the drain pipe is closed by a billet of wood. The well is on the cellar floor, three feet from the drain pipe. This arrangement allows direct contamination of the well by sewage.

8. L——, Cottage Street. Two cases. Cesspool in yard covered in by gravel. The waste pipe opens directly under the front step, and from here a part of the water ran into the cesspool. Very foul odor. At time of the examination there was a high wind. These examples are a fair average of all the houses where an examination was made.

9. B——, Cottage Street. Five cases, the first in the present epidemic. The house is connected with the town sewer. The waste pipe and the ventilating pipe enter the drain together, and at the time of the investigation the opening of the drain pipe was stopped up with rags. The rags had not been put into the pipe until after the local board of health had made an investigation of the sanitary condition of the house.

10. Hotel. Two cases. Town sewer. The hotel is situated on a steep bank which slopes directly down to the river Manhan. At the time of the examination, under the kitchen floor was a foul soft mud, which allowed an iron rod to sink into it ten inches. This part was drained by a broken tile drain which emptied into a small cesspool, about two feet in all dimensions, just outside the hotel. The lessee of the hotel said that when he superintended the opening of this cesspool the odor was so foul that he lost his breakfast.

Under the rear part of the hotel is a small cellar which contained so much water that it had to be bailed out before the plumbers could get in. At the time of examination it was wet and foul; through it ran a broken iron drain. As the drain was stopped up the trap on the urinal waste pipe had been opened, so that the waste from the urinal ran directly upon the cellar floor.

Nashawannuck Manufacturing Company. Sewer runs directly into the pond on which the factory is situated. The rooms appeared to have good air; in each room were two doors for closets supplied with water by an overhead tank.

At Easthampton is situated the Williston Seminary, a school for boys and young men. There are about one hundred scholars in the seminary and there has not been a case of diphtheria. No water is supplied in the bed-rooms. In the urinals there is constantly running water, and the closets are flushed from overhead tanks; examination of the vaults showed them to be clean and free from odor.

Prof. W. T. Mather of Williston Seminary has examined several specimens of well water taken from different houses through the town. Through his kindness I am enabled to report an examination of seven wells. Three came from houses where there had been cases of diphtheria; all were bad. One "very dangerous" came from a well which is five feet from the cesspool.

Aside from these examinations, in two houses where diphtheria appeared it was reported to me by the agent of the local board of health that an analysis of the water had shown it to be bad.

Analysis of Well Water by Prof. W. T. Mather.

	1.	2.	3.	4.	5.	6.	7.
Solids (grains per gallon), .	11.4	13.6	-	-	-	16.6	15.2
Chlorine (grains per gallon),	1.5	1.8	6.6	1.65	1.3	3.85	3.5
Free ammonia (parts per million), ...	.52	-	.058	.0612	.124	.370	.068
Albuminoid ammonia (parts per million), . . .	.244	.05	.164	.088	.156	1.754	.126
Remarks, ...	Bad water.	All right.	Dangerous.	Clean well.	Dangerous. Diphth.	Very dang's. Diphth.	Dangerous. Diphth.

To review the matter in a few words: an epidemic of diphtheria has appeared in a town which has in previous years been remarkably free from infectious diseases, and has in general had a low rate of mortality. Sixty cases, two-thirds of the whole number, occurred in a small district situated at some distance from the most thickly settled part of the town. Investigation has shown that almost invariably the sanitary condition of the houses in which diphtheria occurred was bad, and in several of the houses the water supply was in close connection with foul and broken drains. In all cases where the water has been examined it has been found to be bad.

The first cases reported, 5 in number, were in the family B—— on Cottage Street. No member of this family had been out of town. The first member taken sick was a boy nine years of age; he attended the Chapel Street school and came home from school with a headache and sore throat. Within a few days the four other children had the disease. Mrs. B—— asserts that no one visited the house while the disease lasted and the children did not go to school.

Two weeks later a few scattered cases appeared in the centre of the town and on North Street, which is situated at some distance from the town. On December 30 the epidemic began which spread to such an extent on the plateau towards Mount Tom. The cases as they appeared in the centre appeared to be limited to the houses in which they originally appeared, and in no instance did the disease spread to adjoining houses. On the plateau the disease crept gradually along from house to house. It is difficult to find a satisfactory cause for this difference in the course of the disease in the two sections of the town.

As soon as a case of diphtheria appeared in a house the family was quarantined and a red flag placed upon the house; in spite of these precautions it is known that several families, in all of whom diphtheria appeared, associated together during the disease.

Most of the children on the plateau attended a school on Chapel Street. An investigation of this building showed it to be in good condition. In the rear is a vault which at the time of examination was in good condition. One of the buildings was closed where there was a case of diphtheria in an adjoining house.

On February 1 a milkman was taken sick, and continued on his route for several days before diphtheria developed. An investigation of the matter shows that it is impossible to trace any of the cases to this man, as of fifty-six families supplied with milk from this farm only one had diphtheria. Diphtheria appeared in this family four weeks before the milkman had the disease.

As no proof can be offered as to the spread of the disease in the district described as the plateau, I desire to call attention to the most salient features of the investigation.

First. The geological formation of the land on the plateau is such that cesspools and surface drainage are dangerous. This is dependent upon the layer of clay, a few feet below the surface of the ground, which prevents the water from sinking into the ground. A proof of this theory is found in the bad condition of all the well water which has been examined.

Second. In many instances the wells are placed in close proximity to the cesspools, or, what is more reprehensible, in a cellar through which runs a broken or leaky soil pipe.

Third. The very bad condition of the soil pipes in many of the houses.

Fourth. The town has introduced an abundant supply of good water but has failed to lay sewer pipes capable of carrying off the increased amount of sewage necessarily dependent upon the introduction of an abundant supply of water.

In closing I would like to express my thanks to the chairman of the selectmen and the agent of the board of health of Easthampton for their courtesy in doing all in their power to aid me in my investigation.

Respectfully submitted to the State Board of Health.

HENRY JACKSON, M.D.

JUNE 16, 1890.

Diphtheria at Uxbridge.

Uxbridge, population 3,300 to 3,400. Town composed of several villages; has eight to ten mills; three rivers, West, Blackstone and Mumford, on the banks of which, or on canals therefrom, the mills lie. Has three physicians, two actively practising; the board of selectmen act as board of health. Either the records are imperfectly kept or cases are not reported; it seems at present the latter. Where several cases of contagious disease break out in succession, only the first case in each family seems reported. Then the physicians report orally to the selectmen anywhere, and not in writing.

The town has a water supply from springs pumped to a reservoir. It was a private supply but is now owned by town. The town water does not reach Heclaville, situated between West and Blackstone rivers, nor Wheelockville, nor across the Blackstone. There is no system of sewerage.

Town records show measles and some diphtheria in 1885. In 1886 little or nothing recorded. In 1887 there were 12 cases of diphtheria, but 6 were in one family. In 1888 there were 19 cases of scarlet-fever. In 1889 nothing recorded. In 1890, May to August 26, there have been 36 or 37 cases of diphtheria, 4 deaths therefrom. Four fresh cases at date, August 26; 2 in one family and 1 in a family in the house next beyond. Most of these cases in Heclaville were in houses where one, three, four and nine families live, and in other cases (save two or three) there is relationship, or connection by work with the mill opposite. In six houses, comprising twenty families, and one boarding-house with less than one hundred, probably fifty feet removed from one another, there have been 29 cases of diphtheria, and 4 deaths; 3 cases, included in 29, at present.

Mary L——, a young woman under twenty, was the first person affected, May 1, 1890; case called quinsy, till a day before death. The neighbors came in and laid her out; no public funeral was allowed. Two possible sources of contagion were reported; one, that she attended a funeral in a neighboring town about two weeks previously; it is denied that this death was from diphtheria. Secondly, that she attended a ball in Woonsocket before she came down. The latter seems the probable source of contagion. Five others in the same family became sick.

Then on May 18 the family G——, in the same house, below, had eight children and one grandchild sick, of whom one child and the grandchild died. The mother came from another town to her home, had the disease, and also her child, a baby.

One other family living in this house, G——, had a child sick May 25, which died.

Wooden box drains carry kitchen water down into covered drain running into open cesspool, now covered. This open cesspool served for the O'B—— house. G——, senior, says occasionally smells came in kitchen window, after rains, or from wooden drain from above. Well back of house seems safe. The G—— child in same house was sick May 25, dying later. The health records are so incomplete that dates are wanting.

But the six houses most affected have had cases from May to present time, August 26. On June 10, one in the family living in next house, seventy feet distant, on same side, having their closed drain run into the open cesspool common to both houses; and on June 7, four O'B—— children, in the same house, came down.

The H—— child became sick on May 27. The man supplies milk from Hecla Company farm. The house is perhaps one hundred yards remote from the K—— house, and is a better one. The child probably had contact with the other children, possibly went with the father. G—— child, with a rag around its throat, was seen about the H—— house.

Miss D——, living one mile north, was taken sick June 14; she worked at the Hecla Mill, and would have to come into Heclaville, and into contact with the people there.

A D—— case in May, one-third to one-half mile remote, not traced; probable connection with mill people. June 20, man named H——, living on east side of Mumford River, a mile from Uxbridge village, became sick. There had been trouble over ten or twelve years about drains. The cesspool overflowed while H—— was sick. The man worked at Calumet Mills, run by same firm as Hecla, but remote a mile.

There was a brief time in July when no cases appeared. In August, L—— child was taken sick. Mother stated the G——s, nearly opposite, had been convalescent three or four weeks. House has open drain running from house to an open and bad cesspool near privy. The K—— family had one case August 11; house south of L——, eighty feet, or, as given by Dr. Johnson, one, a child on August 1 and the mother, August 26. The K—— house has also a bad open cesspool; the drain is covered.

On August 4, an F—— child, living at Wheelockville, became sick with diphtheria and mumps; the child went into the woods and drank out of tank where cattle drank. Some others went with her. The mother works in the Calumet Mill, run by the proprietors of Hecla. Wheelockville is a mile from Hecla, south. There was probable contact with L——s boarding-house.

On August 12, the M—— children, just north of L——s, were taken sick; two of the four being comfortable now. There are nine tenements. The M—— family occupy south end. There is an open cesspool.

August 14, G—— child; not traced. Mother works in Calumet Mills.

August 16, K—— child, living just south of L—— already mentioned.

August 18, R—— children, just north of M——s. Drain also into open cesspool.

August 23, T. O'B——'s child; store, half mile off; child cousin of the other O'B——s. The drain once dammed back under bedroom window. Granite store beneath.

There had been attempts made to disinfect rooms with slaked lime, washing, etc. The physicians seem to have thoroughly cared for the patients.

Recommended, *First*. The written communication of every case in each family to the board of health by the physician.

Second. The placarding of infected houses.

Third. Permits to enter school given by health board, on certificate of physicians.

Recommendations with reference especially to the six tenements, and other places, or houses having open drains, cesspools, wooden conductors, etc.

Fourth. The wooden drains, leading from second story down the outside of the house, into the conducting drain, should be newly boarded or replaced by earthen or iron pipe. The people on lower floor state that the smell comes into their sink-pantry room when water is poured into drain above.

Fifth. That drains conducting from the house be buried; if now of wood, they should be replaced by earthen pipe, as the drains that are closed pass near wells. That has been done with some of the houses.

Sixth. Proper covered cesspools should be dug, and replace open ones smelling badly and now placed near the privies. A better way in the end would be to have covered pipe drains lead to a sewer pipe not far remote, which discharges into the river. Then when the town introduces town water, across the Blackstone, sewerage will be ready. Perhaps the down flush at present would be insufficient.

Seventh. The sinks now without them should be provided with traps.

Eighth. The cesspools that are covered should be emptied more frequently, as at the T. O'B—— house and store. The rains or stoppage dammed the sink water, etc., back under the bed-room window.

Ninth. The sink-rooms should be whitewashed.

Tenth. People should be informed that diphtheria is a dangerous disease, and that its poison may break out afresh months afterwards.

PRESTON SHELDON, M.D.

Typhoid Fever.

The prevalence of typhoid fever has not differed very much throughout the State in 1890 from the year immediately preceding, so far as can be learned from the imperfect returns of 1890.

If a series of years be examined, however, the data show that there has been a decided improvement from one decade or quinquennial period to another, the death-rates from this cause being as follows for the census years 1865 to 1885: —

Death-rates per 10,000 from Typhoid Fever in Massachusetts.

1865,	13.4	1880,	4.9
1870,	9.1	1885,	3.9
1875,	6.4		

The following table presents the number of deaths from typhoid fever in the 28 cities of Massachusetts for a period of nineteen years (1871–1889), together with the average annual mortality ratio per 10,000 of the living population from the same cause.

The average ratio for all the cities was 5.43 per 10,000 of the population. This is estimated from the population of the census year 1880, which may be taken as an average for the period. In the case of nine cities, in which the rate of growth in the last half of the period differed essentially from that of the first half, the actual mortality might differ slightly from that which is stated in the table.

The cities which had a higher mortality from this cause than the average were in the order named: —

Holyoke,	11.32	Lowell,	7.53
Lawrence,	8.42	Fall River,	7.21
Chicopee,	8 25	Pittsfield,	5.95
Springfield,	7.74		

Those which had a lower rate of mortality from the same cause were: —

New Bedford,	5.36	Malden,	4.55
Taunton,	5.34	Chelsea,	4.49
Haverhill,	5.30	Fitchburg,	4.02
Brockton,	5.30	Somerville,	3.95
Boston,	5.02	Gloucester,	3.95
Salem,	4.99	Cambridge,	3 79
Northampton,	4.93	Newburyport,	3.62
Marlborough,	4.88	Newton,	3.56
Quincy,	4.88	Woburn,	3.37
Lynn,	4 68	Waltham,	2.43
Worcester,	4.58		

Deaths from Typhoid Fever in Cities of Massachusetts, 1871–1889.

	FIVE YEARS.	TWO YEARS.														
	1871-1875.	**1876-1877.**	**1878.**	**1879.**	**1880.**	**1881.**	**1882.**	**1883.**	**1884.**	**1885.**	**1886.**	**1887.**	**1888.**	**1889.**	Total Nineteen Years.	Average Annual Death-rate from Typhoid Fever per 10,000.
Boston,	1,145	313	106	120	151	212	223	167	202	148	142	180	174	176	3,459	5.02
Worcester,	176	67	20	13	31	21	28	18	20	19	19	30	25	21	508	4.58
Lowell,	221	46	27	22	22	54	50	49	41	49	50	90	62	69	852	7.53
Fall River,	176	68	26	23	35	32	51	33	26	32	30	45	46	48	671	7.21
Cambridge,	124	31	8	6	10	21	18	22	26	16	21	22	31	24	380	3.79
Lynn,	118	21	13	12	26	25	28	22	18	16	13	12	14	6	344	4.68
Lawrence,	190	42	30	23	27	49	31	28	19	17	23	47	48	55	629	8.42
Springfield,	214	44	18	8	16	27	22	28	18	22	12	17	26	19	491	7.74
New Bedford,	99	30	9	9	2	12	12	8	23	7	25	6	11	21	274	5.36
Somerville,	69	15	6	4	8	6	8	13	8	10	3	12	17	8	187	3.95
Holyoke,	157	31	7	19	20	30	58	21	23	18	17	17	21	23	471	11.32
Salem,	87	20	8	11	22	19	13	15	6	13	16	12	11	8	261	4.99
Chelsea,	86	15	10	2	9	9	5	5	10	8	4	6	6	11	186	4.49
Haverhill,	46	17	8	9	6	6	13	9	11	13	16	17	6	9	186	5.30
Brockton,	43	4	3	1	6	17	8	9	4	3	9	8	13	9	137	5.30
Taunton,	65	12	8	5	9	16	19	7	8	9	17	24	7	9	215	5.34
Newton,	20	10	6	5	4	6	5	1	11	8	6	8	12	13	115	3.56
Malden,	25	14	4	6	7	5	6	4	2	4	8	8	3	8	104	4.55
Fitchburg,	32	5	3	3	6	4	2	2	5	5	6	6	9	7	95	4.02
Gloucester,	51	15	11	3	5	7	7	10	7	7	7	4	9	2	145	3.95
Waltham,	13	1	2	1	4	5	3	3	6	3	5	5	2	1	54	2.43
Pittsfield,	56	15	1	4	9	7	10	5	10	2	8	10	9	5	151	5.95
Quincy,	19	11	3	1	6	2	8	3	8	6	1	12	12	6	98	4.88
Northampton,	46	6	6	3	4	8	2	7	10	2	6	3	6	5	114	4.93
Chicopee,	63	15	5	7	8	11	3	15	10	9	4	10	11	6	177	8.25
Newburyport,	29	11	3	10	7	7	6	2	3	4	1	3	2	5	93	3.62
Marlborough,	27	7	5	4	4	4	4	4	4	4	9	6	5	7	94	4.88
Woburn,	26	6	–	3	1	1	7	2	2	2	4	2	7	7	70	3.37
Totals,	3,423	892	356	337	465	632	650	512	541	456	482	622	605	588	10,561	5.43*

* Average, 28 cities.

Recognizing the fact that typhoid fever is very largely a disease, the infection of which is conveyed through the medium of the drinking water, the condition of the population with reference to their water supplies bore a very marked contrast between 1865 and 1885, since at the earlier date a majority of the population were dependent upon wells (very many of which were polluted) for their water supply, while from that date to 1885 the introduction of many public supplies of a pure and wholesome character was very rapid. Had it not been for the fact, as recent investigations have shown, that the public supplies of some of the large cities were annually becoming more and more polluted, the death-rate from this disease would undoubtedly have shown a still greater diminution.

The attention of the Board has been called during the year to certain outbreaks of a limited extent.

At the Sturtevant works, located on Stony Brook in Roxbury, employing about 350 men, there were in the fall of 1889 about 35 cases of illness, and one death. A portion of the cases of illness were reported to have been typhoid fever.

The water used for drinking purposes was from two sources; from the city supply and from a well on the premises. The faucets supplying the latter had been closed before the visit of the secretary of the Board to this establishment (Oct. 18, 1890). The first case occurred in August, 1890. The well which had been used as a partial drinking-water supply is located on the bank of the brook, and not more than five feet distant from it. It is about twelve feet deep and had about three feet of water in it at time of visit. The level of the water in the well being about the same as in the brook, in time of high water the water of the brook might pass directly into the well. Above the well, in an adjoining yard, at a distance of about fifteen feet and at a height of about ten feet or more above the water in the well, was a very filthy privy vault, which was full and running over. The contents of this vault in a rainstorm might flow with pretty direct course down a slope toward the well. Inquiry at the two tenement houses in this yard did not elicit any information as to the previous existence of typhoid fever at either of them. Stony Brook, which passes directly by the well and probably furnishes a part at least of its water, receives sewage from a considerable territory above the works.

Typhoid Fever occurring upon a Milk Route.

Several cases of typhoid fever occurred in Newton in September, October and November, 1890, in a limited locality near the Nonantum mills. There were comparatively few cases in the city at the time. The principal point in common among these cases was the milk supply. All of them took milk from one milkman living in Waltham. On further inquiry it was found that other cases occurred in Watertown among the customers of the same milkman. Upon the routes of sixty or more milkmen in the same city it was not learned that there were any other cases of typhoid fever.

On visiting the dairy in question it was found to be in good condition; the stable and house being both new and neatly kept. The proprietor kept about ten cows and purchased some milk from another dairy farm ten miles distant. When the house and barn were built the owner dug a well in the rear of the stable to furnish water for the cows and for washing. In the dry weather of the summer of 1890 the well failed to yield a sufficient supply of water, not being deep enough, and a new well was dug, work being begun upon it about the middle or last of August. Meantime, while the new well was being dug, water was obtained from the house of a neighbor. At this time there were four cases of typhoid fever at the neighbor's house, one of which died soon after. The well from which the dairyman obtained his temporary supply of water was in a small out-house attached to the barn. In the barn cellar, and about twenty feet from the well, was a pool of liquid filth or manure about one foot in depth, extending over a large part of the bottom of the barn cellar. The family at this farm-house used the water of another well situated in front of the house as their water supply. The dairyman claimed that the only use to which the water obtained from the neighboring farm-house was put, was for drinking purposes, and not for the washing of milk-cans or other work in connection with the milk supply. The room in which the cans were washed was neat and well kept. It contained a small boiler in which water was being heated at the time of the visit. Cans were being washed, as well as glass jars, since this milkman had a considerable demand for milk delivered in this manner. It was quite plain that the water used for washing was not brought to the boiling point, but was scarcely more than lukewarm.

The farm-house at which the cases and death from typhoid fever occurred was closed at the time of the visit and nothing could be learned from the family.

The facts, then, so far as known may be summed up as follows: —

Typhoid fever existed at a farm-house in August, 1890, occupied by one B——. A neighboring dairyman, G——, has a well which became dry in August. He obtains water from a well at the house of B——. His milk cans are imperfectly scalded. He distributes milk in Waltham and Watertown. Typhoid fever appears among his customers in each of these places early in September; but few other cases existed in either of these towns at the time. The typhoid germ was not found in the water of the well at the house of B——, although search was made for it. In fact, it was not looked for until November, at a time when, if it had existed, it had probably disappeared. We cannot therefore conclude that it did not exist at a previous day. It appears probable that the typhoid infection did exist there and that in some way the infection passed from the sick persons in B——'s house through the medium of the cesspool, the barn cellar, the well and the milk-cans of G—— to the alimentary tracts of G——'s customers in Waltham and Watertown.

HYDROPHOBIA.

In the last annual report of the Board, page xxvii, reference was made to the prevalence of hydrophobia in the State during the previous year. Since the date of that report observations have been made upon the prevalence of the disease which tend to show that there has been a considerable increase in the number of cases of rabies among animals, as well as of hydrophobia among human beings. The extent or area of its prevalence has also been much greater than it was in 1889, in which year it was confined mainly to the eastern counties of the State.

For the purpose of comparison a brief review will be presented of its occurrence in the State during the past forty-eight years of registration, such facts being presented as relate to the mortality from this cause among human beings.

The whole number of deaths recorded from this cause in the State from 1842 to 1890, inclusive, was 106; of this number 87, or 82.1 per cent., were males, and 19, or 17.9 per cent., were females.

The geographical distribution of cases was as follows: —

Deaths from Hydrophobia by Counties for the forty-eight years, 1842–1890.

Barnstable,	2
Berkshire,	2
Bristol,	14
Dukes,	1
Essex,	16
Franklin,	2
Hampden,	7
Hampshire,	1
Middlesex,	23
Nantucket,	–
Norfolk,	16
Plymouth,	3
Suffolk,	13
Worcester,	6
	106

By way of comparison the statistics of the United States for the census year 1880 are herewith presented, together with those of England, as given by Dr. Longstaff in his excellent volume entitled "Studies in Statistics." *

Deaths from Hydrophobia, by Months.

	LONDON.	UNITED STATES.	MASSACHUSETTS.	TOTAL.
	1883-89. Seven Years.	Census Year, **1880.**	Forty-eight Years, **1842-1890.**	
January,	4	8	7	19
February,	1	6	7	14
March,	5	3	9	17
April,	4	9	10	23
May,	4	5	10	19
June,	5	9	9	23
July,	4	7	6	17
August,	9	13	13	35
September,	11	5	7	23
October,	4	7	12	23
November,	8	6	7	21
December,	6	2	9	17
	65	80	106	251

* "Studies in Statistics," by Geo. B. Longstaff, M.A., M.B. London, 1891.

Deaths by Ages.

	YEARS.																		TOTAL, ALL AGES.
	Under 5.	5 to 10.	10 to 20.	20 to 25.	25 to 35.	20 to 30.	35 to 45.	30 to 40.	45 to 55.	40 to 50.	55 to 65.	50 to 60.	65 to 75.	60 to 70.	Over 75.	70 to 80.	Over 80.	Unknown.	
England and Wales, 35 years, 1854-88, .	108	169	196	75	129	–	96	–	72	–	49	–	23	–	3	–	–	–	920
United States, 1880,	9	11	14	–	–	4	–	13	–	6	–	9	–	7	–	5	1	1	80
Massachusetts, 1842-1890, . . .	13	20	24	–	–	10	–	13	–	9	–	9	–	5	–	1	1	1	106
	130	200	234	75	129	14	96	26	72	15	49	18	23	12	3	6	2	2	1,106

The statistics of the United States census relative to hydrophobia were not taken in an epidemic year. There were 80 deaths from this cause registered or returned by the census officials for 1880, out of a total of 756,893 deaths from all causes, being a ratio of about 1 in 10,000 deaths. They were distributed with considerable uniformity throughout twenty-one States, of which Texas had 10 ; Pennsylvania 10 ; Ohio 9 ; Louisiana 8 ; Illinois 6 ; Mississippi 5 ; South Carolina 5 ; Arkansas, Kentucky, New Hampshire and North Carolina 3 each ; Connecticut, Delaware, Iowa, Minnesota and New York 2 each ; and California, Colorado, Indiana, Kansas and Wisconsin 1 each.

Of the whole number, 56 were males and 24 were females.

Out of 920 deaths from this cause in England 722 were males and 198 females.

From these statistics it appears that the greatest relative as well as absolute mortality from this cause occurs between the ages of five and ten years, and next after this in the succeeding period of ten to fifteen years. The explanation of this, as stated by Dr. Longstaff, "may perhaps be, that of those bitten a greater number of children contract hydrophobia ; there may be a greater predisposition at those ages. On the other hand, it should be borne in mind that young children are less completely clothed than adults, and their partially naked limbs are without protection against the saliva of a rabid dog ; moreover, they are less able to defend themselves against attack, and to some extent the small size of their limbs is a danger, the dog getting hold of a small limb more easily than a large one, though perhaps this point is not so important here as in the case of snake bites."

At all ages, except the extremes of life, many more men than women die of hydrophobia. At the extremes of life the conditions as to occupation and habits are similar; in middle life men are brought much more in contact with animals by their occupations, and are not so well protected by their clothing, — since all authorities lay much stress on the efficacy of clothing in wiping off the saliva from the teeth of a rabid animal.

Many more persons are bitten by rabid dogs than ever develop hydrophobia.

During the past year, from May 1, 1890, to May 1, 1891, the Board has endeavored to ascertain as nearly as possible the facts as to the actual prevalence of hydrophobia in the State. The sources of information have been mainly the physicians and veterinary surgeons in the cities and towns of the State. Much valuable aid in the way of "pointers" has been afforded by the local newspapers of the different localities, and while these sources admit much that is sensational and unreliable in character, they have served to guide the investigation in the search of the actual facts. Every attempt has been made to eliminate the truth from falsity and exaggeration, by means of correspondence and personal interviews with parties cognizant of the facts. Hence it is believed that the following summary is measurably correct.

In fifty-five cities and towns there were 99 outbreaks of rabies reported, in which human beings, dogs and other domestic animals were bitten by rabid dogs. The number thus attacked cannot be given, since in many instances it was indefinitely stated. In one instance, Newburyport, May 30, it was stated that 17 dogs were bitten; in another, Marblehead, 4 dogs and a cat; in another, Chicopee, 4 dogs, 1 cat, 2 calves and 3 cows; in another, Farnumville, 33 fowls, a man and a dog; in another, West Springfield, 30 dogs; in another, Worcester, 3 men and 2 boys; in another, Sharon, 15 dogs, etc.

In many of the foregoing instances the affected animals were shot by policemen or others, and some of the animals bitten were similarly dealt with. In one instance the very sensible course was adopted of placing the suspected animal in restraint and feeding him, until it could be determined whether he had rabies or not. As the disease is invariably fatal, the diagnosis is not difficult.

The foregoing outbreaks occurred in the following ten counties: Berkshire, Bristol, Essex, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk and Worcester; none were reported from Barnstable, Dukes, Franklin and Nantucket.

In addition to the foregoing instances, all of which occurred between April 1, 1890, and April 1, 1891, there were 32 instances in twenty-four cities and towns which were of such a nature as to render it doubtful whether the dogs had hydrophobia or not.

There were also 47 other instances, occurring in thirty-four cities and towns in which persons were bitten by dogs, in which it was reasonably certain that neither the dogs nor the persons bitten were affected with hydrophobia. Some of these were vicious dogs, or dogs which had been worried or irritated by children or others. Nine such instances were reported from Fall River, 8 from New Bedford and 7 from Lynn.

Of the persons in the State who were reported as having been bitten by rabid dogs during the period in question, fifteen are reported as having gone to New York for special treatment by Dr. Gibier. So far as can be learned none of these persons have thus far contracted hydrophobia.

The dogs referred to in the foregoing instances as having become rabid were, so far as the breed was specified, of all kinds, and no one breed or size appeared to predominate. Newfoundland, St. Bernard, mastiff, setter, shepherd, bulldog, terrier, black and tan, coach dog, hound, etc., all appear in the list.

One feature is noteworthy as possibly suggesting a partial remedy, and that is the predominance of dogs without collars, — vagrant, stray and wandering animals running about from one town to another without home or master. This class of dogs appears to be more subject to rabies than any other, and more stringent laws are required, or possibly a better execution of present laws, to diminish the number of this class.

Dr. Longstaff alludes to this fact as follows: —

> When affected with rabies the dog develops an irresistible tendency to wander from his home, and in the course of his travels he snaps and bites at any person or animal that happens to come in his way,

and thus the disease is spread. The first and most essential thing to be done in the suppression of rabies in a district, therefore, is the seizure and destruction of all wandering dogs. The necessity for this is apparent from the rabies returns of the past year, which show that of the 312 rabid dogs, 121, or over 38 per cent., were returned as stray dogs, which, if not exactly ownerless, were, when found diseased, so far from their owner's premises that the ownership could not be traced.

The following correspondence relates to cases which were reported either by boards of health, attending physicians, or by veterinary surgeons having cognizance of cases of rabies: —

Lowell. — Out of six veterinary surgeons, two only reported having seen cases of rabies in dogs in 1890. One of these had observed two cases, the other "never had a case till the fall of 1889, and then saw about twelve cases by the next summer, and has had no case since then." The diagnosis in some of these was doubted by another physician, who says his own dog was pronounced rabid, but recovered after having bitten the physician's boy. There were two deaths from hydrophobia in Lowell in 1890.

Lawrence. — The correspondent writes: "The case of hydrophobia was in a child of two years and seven months. He was bitten by a dog upon the cheeks, nose and lips on March 4, 1890. The wounds healed readily in a few days. The child appeared well till May 3, 1890, and died in three days. The first observed symptom was difficulty in swallowing. I saw the child May 3, late in the day, and then it manifested terror at sight of anything to drink, had spasms, eyes rolling about, pupils dilated, thirsty, but not feverish; at times would scratch and bite his parents. On the third day he became dull and drowsy; attacks of fear, terror and spasms, not so acute and less frequent till night, when he died."

New Bedford. — "No case in man or beast known in this city for the last ten years."

Milford. — "Four dogs considered rabid were killed, and eight other dogs bitten by them were also killed, before there was any evidence of disease."

Leominster. — "No well authenticated case of rabies so far as I know. Last year there were, I believe, two dogs killed in town as having been bitten by a stranger dog, but in both cases there were, as far as came to my notice, few if any symptoms."

Taunton. — "No rabies among dogs for a year, unless a dog in February last may have had rabies. He was a house dog and presented peculiar symptoms. On the night of the day preceding his supposed attack he got into bed with the little boy with whom he played. He persistently licked the faces of the boy and his mother. The mother got up at four o'clock and let him out, and that was the last time they saw him. He was seen by others that day running through the streets biting and snapping at any man, dog or cattle which came in his way. He was finally killed in Stoughton. None of the persons bitten have thus far shown signs of hydrophobia."

Gloucester. — "Do not know of a case of rabies or hydrophobia in Gloucester in 1890."

Watertown. — The following case was reported in the "Boston Medical and Surgical Journal" of April 24, 1890, by Dr. J. A. Mead of Watertown: —

On the 29th of November, 1889, I was called to see a boy seven years old who had been bitten on the leg by a dog. The dog was shot by the chief of police, who informs me that he did not consider him mad. There were three wounds on the leg, two of which were quite large; the other was superficial. The wounds were sewed up and dressed; they healed by first intention, and the boy was soon around as well as usual.

On the 12th of April, 1890, I saw the boy with Dr. M. J. Kelley. The parents told me that he had had diarrhœa for a week and that he had seemed more nervous and restless than usual. He had not been considered sick enough to require the services of a physician. Early on the morning of the 11th they were startled by his refusal and inability to swallow water. I saw him on the afternoon of the same day. At this time he could and did eat a banana, which he swallowed very rapidly; but he was thrown into a convulsion whenever water or milk was offered him. He had a wild, unnatural look in his eyes, the pupils of which were widely dilated. He was seldom still while I observed him, but was continuously twitching his arms and shoulders, and throwing his arms about. His breathing was at times labored and difficult. During the night of the 11th he had repeated and very severe spasms, accompanied by frothing at the mouth.

I saw him again on the 12th. He was mildly delirious. He swallowed a pill with a speed that was astonishing; he then clutched a glass of water about a quarter full and with lightning speed swallowed it at a gulp. As he lay back on the pillow, exhausted with his effort, he gasped, and said to his mother, "I can swallow water; you are too slow."

At noon of the 12th he had spasms that lasted an hour. During the afternoon of the 12th the delirium became more marked and the spasms more severe. These spasms occurred at intervals until five o'clock of the morning of the 13th, when he died. During the 12th he vomited considerable clotted blood.

Temperature, taken in the axilla on the 11th and 12th, was normal. The pulse was rapid and small.

Chicopee. — "A case of rabies occurred in Chicopee, but fortunately, no fatality has so far resulted, as the bitten were treated in New York. As the cattle bitten by the dog were attacked by the disease, there is little doubt that it was a genuine case."

Malden. — "Am not aware that there was a single case of rabies in Malden in the past year. The chief of police informs us that 126 'tramp dogs' were killed, none of which had evidence of rabies."

Cambridge. — "Have knowledge of but one case; a man was bitten. The dog was killed."

Holyoke. — "No case of hydrophobia has come to my notice in Holyoke since Jan. 1, 1890."

Woburn. — "Saw J. C., eleven years old, June 22, 1890. He was bitten by a dog in April, 1890. Was bitten on the arm. The attending physician applied a plaster to the wound. Had been in convulsions an hour when I saw him. Every time I gave him medicine in water he had spasms. I gave him an enema of chloral, fifteen grains, and potassium bromide, thirty grains, every two hours, which controlled the spasms. He was conscious much of the time. He died in a spasm."

Melrose. — One death from hydrophobia reported; a boy aged nine years and nine months. He was bitten by a mad dog May 12, 1890, at half-past eight A.M. He was taken ill June 20, 1890. A physician was called on the same day, June 20. The boy died June 21, 1890, at six P.M.

Medford. — During 1890 a large number of dogs were disposed of because of suspected rabies. How many were actually rabid is unknown to the Board, as the dogs were immediately killed on being suspected of the disease. One case we believe to have been rabies. This occurred in April, and a child, a cow and several dogs were bitten. The report of the case of the child was furnished by the attending physician. The dogs were dispatched at once; the cow was quarantined, and in the latter part of the month was killed, while undoubtedly suffering with hydrophobia. The report is as follows: —

"April 2 I was called to see a girl six years of age, who had been bitten about the face and neck by a dog. The wounds were closed, using twenty-one stitches. All the wounds except one united by first intention. In this wound an abscess formed, which discharged for several days. After this the child, to all appearances, recovered and seemed as well as ever. Was out of doors playing with other children several days. I was again called, April 20, when the mother gave me the following history: On Friday, April 18, she noticed that the child was cross and irritable and did not appear natural. Was much disturbed by noise. On night of 18th was restless and irritable, not sleeping well, all of which was in contrast with her usual good temper. On the 19th she showed symptoms of fever, and had several attacks of vomiting. On the 20th temperature was 99⅖, pulse 130, pupils largely dilated. Complained of pain in head, was disturbed by light and noise. Took liquid nourishment during the day. Was very thirsty, drinking freely of water. Vomiting less frequent. On the morning of the 21st the mother attempted to swab the mucus from the child's mouth, when she had a spasm. Temperature was 99⅘, pulse 135. Had not slept during the previous night. At this time she was unable to drink water, and shrank from it with a look of horror. On attempting to drink she would be thrown into a spasm. She had not such a dread of milk, and would try to drink it, but usually, even if it did not cause a general spasm, the spasmodic action of the muscles of the throat would prevent swallowing it. She was less disturbed by noise and light than on the previous day. There was tenderness over the spinal column, especially marked in the cervical and upper dorsal region. On the 22d, pulse 140, respiration 26. Spasms at irregular intervals through previous night; semicomatose. Not disturbed by noise or light. Spasms had increased in frequency and violence, each spasm developing a more marked cyanosed condition by interference with respiration. The expression of terror at the mention of water, and her efforts to get away from it when brought to the bedside were decidedly pronounced symptoms, which I have never before seen. Spasms continued during the night of the 22d, and she died at half-past twelve A.M. on the 23d."

Boston. — F. F., aged five years, was bitten Oct. 30, 1890; taken ill November 13, and died Nov. 15, 1890. Case seen by four physicians; had all recognized symptoms of hydrophobia. Relief was had from morphia, but not from bromides. Death sudden.

The following notes are copied from "Boston Medical and Surgical Journal" of April 17, 1890. The case occurred in the service of Dr. H. H. A. Beach of the Massachusetts General Hospital: —

The patient, who lived in Quincy, presented himself at the hospital on the morning of April 9 at eight o'clock, with his father, who gave the following history: Three weeks before his son was bitten by a sick puppy, which died the next day "in fits." The wound was a mere scratch on the left forefinger, and healed in two or three days. The patient thought no more of the accident. Seventeen days later he began to have acute pain in the scar, shooting up the arm, for which he sought medical treatment, without relief. The next day the patient's "throat began to contract;" in a few hours he was able to swallow nothing. This state of affairs, with increasing weakness and anxiety, had persisted up to the time of entering the hospital, four days after the first symptoms. The son himself added that water was especially distasteful to him, and that at times he had great difficulty in breathing, but for the past twenty-four hours he had had no pain in the hand and arm. Such was the alarming appearance of the patient, that on his presenting himself at the hospital the porter sent word to the house officer that he thought the case was one calling for immediate tracheotomy.

Examination: Man, thirty-five years of age, very restless, with staring eyes, who started back in apparent fright when approached. The least stir in his neighborhood caused convulsive movements of the pharynx. He would wave his arms, start back violently, and the spasms of the pharynx would soon become accompanied by expulsive movements of the chest and abdominal muscles. He kept appealing eagerly for assistance. His voice was gasping and sobbing in character. Pulse, 108 and of good strength; respiration, 27. He told a connected story and seemed quite rational. There was a small, soundly healed scar on the left forefinger. About half-past five in the afternoon he became suddenly violent without any warning, though all day he had been perfectly rational and willing to submit to treatment. He had a fixed idea that the consulting physicians intended him some bodily harm, attempted to escape out of a window, and furiously attacked two attendants. At seven P.M. he broke out in a profuse sweat, and began expectorating vigorously at intervals of three or four minutes. At eight o'clock general convulsions began to increase rapidly in intensity and number, especially flexions of arms and legs with clonic contractions of temporals, masseters, buccinators and muscles of pharynx. The patient was violently maniacal at times, quiet for about five minutes, then began rapid muttering delirium, gradually becoming more violent for three or four minutes; from this state he would again relapse into silence, from exhaustion. When violent he spat constantly and accurately at surrounding objects. Up to half-past ten P.M. he refused all liquids, as he had done all day. These symptoms continued, without cessation and with little change, up to half-past ten in the evening of the day of admission, when, in one of his moments of quiet, he suddenly died without premonition.

West Springfield. — A dog bitten about March 1 bit about twenty dogs and was killed by the police. Nearly all the dogs bitten were killed. The first dog bit two boys, who were sent to the Pasteur Institute at New York.

Fitchburg. — "On May 26, 1890, a lad twelve years of age came to my office stating that he had been bitten by a dog which attacked him in the street. On examination a small wound through the skin was found on the left shoulder and in the axilla, with several abrasions over the scapula. The wounds were cauterized and in ten days were healed.

"The dog was presumed by his actions to be mad and was promptly killed, before I had opportunity to examine him. His history before the biting was that some two weeks before this dog was bitten by a stray hound which ran about the city for a time and disappeared. A few days later the owner of the bitten dog noticed a changed disposition, being excited and feverish, with a tendency to bite people, and chew the ropes by which he was tied, thus breaking away and finally attacking the boy. Before the dog was caught he bit three other dogs, two of which showed signs of rabies in two to three weeks. They showed a marked change in disposition, refused food, snapped at whatever was near them, and showed an increasing restlessness; a peculiar dragging of the hind legs, which after two days developed into a more general paralysis; the jaw dropped, abundant saliva ran from the mouth, and finally they died of paralysis and exhaustion three days after showing the first symptoms. I kept one of these dogs at my stable and it was seen by several of the local physicians, all considering it a case of hydrophobia.

"On the basis of the diagnosis it was considered best to send the boy who had been bitten to the Pasteur Institute at New York, to be placed under the care of Dr. Gibier, which was accordingly done June 14, 1890. The case was considered by Dr. Gibier as one proper for treatment and the inoculations were at once begun on June 16, in the usual way. The boy stood the treatment well, and save a slight inflammation about one of the punctures, no accident occurred during the sixteen days that he was under treatment. The boy made a complete recovery and remains well at the present time, nearly a year since he was bitten.

"By advice of the Board of Health all dogs were ordered to be muzzled by the mayor of the city."

Worcester. — "I have been called to many supposed cases of rabies but have only found three cases within a year. The first was that of a gentleman living on Park Avenue, New Worcester. During last fall, his mastiff dog suddenly developed strange and alarming symptoms, and had bitten his trotting horse upon the hind leg, which led the owner to shoot the dog. A few weeks later the horse showed well marked symptoms of rabies and was shot."

"Mr. D. J. Baker of the Elmwood House, New Worcester, had a dog that 'grew very cross and sick,' and bit a cow on the lip, and a horse in the hind fetlock joint. The dog died in a short time, and not long after the cow showed all the signs of true rabies and was shot. The horse seems all right so far.

"Another case was sent from Groton, Mass., with the statement that it had been 'bitten by a stray sick dog,' and they wished me to keep it and see the result. The dog seemed perfectly well for about six weeks, when one afternoon he grew suddenly very snappish and ugly, tearing the attendant's clothes with his teeth and biting at every object within his reach, tearing all the broom-corn from the stable broom, and in every way showing the marked symptoms of rabies. I watched him at intervals for many hours, then shot him. These are all the cases that I have any record of, and they have occurred in my practice only."

Quincy. — "On Dec. 16, 1889, an Irish setter dog, owned in Wollaston, bit a newsboy. The master when chastising the dog was himself bitten. The next day Mr. W——, a neighbor, was bitten by the same dog, — all these bites being in the hand. Mr. W——'s was in the palm of right hand, a wound one and one-fourth inches long and one-quarter of an inch deep, and one tooth mark on the back of the hand. I cauterized carefully all of these injuries and they healed kindly. They were each cauterized as soon after happening as one could travel one-quarter of a mile.

"About two months after, Mr. W—— while at work was unable to drink water. This condition lasted for about twenty-four hours, when I was sent for. Found him excited and thinking he could not drink, — took the cup and told him I believed he could; with some little effort he drank. This I was able to make him do until his death, although with increasing difficulty. His death occurred in nine days. His symptoms consisted in, first, a shuddering on attempt to drink *any* liquid; second, some rigidity possibly; third, loss of power; fourth, considerable excitement (although I took his temperature under his tongue every day and a few hours before his death); fifth, a temperature of 104°; at the end, death from exhaustion. There was no convulsion or anything approaching one at any time, no salivation, no expectoration.

"An autopsy was held which revealed nothing of an abnormal character anywhere. Portions of spinal cord were taken to the bacteriological department of Harvard Medical School and inoculation of rabbits made. The test rabbit lived three weeks and then died from such symptoms that Professor Ernst was not willing to pronounce a diagnosis, and new inoculations were made, the result of which I have never heard. After the death of the rabbit, Mr. P——, the owner of the dog, did not wait to learn the result of the second inoculations, but went to New York and was subjected to the inoculations of Pasteur. He is well and also the newsboy.

"The dog was shot by the advice of authorities at Harvard Veterinary School after his symptoms had been related to them, a post-mortem held, a ball of hair some three and one-half inches in diameter found in the stomach, and a diagnosis of inflammation of stomach made."

"W—— M—— age, 2 years, 9 months; Scotch; always well and strong. About Christmas, 1889, child was bitten on right cheek and left side of nose by a strange spaniel dog not thought to be mad, but immediately killed. Wounds on child healed well and child perfectly well until Feb. 11, 1890. During afternoon was drowsy and slept till 12 P.M., then awoke in excited delirious condition. Convulsive twitchings when he tried to sleep. Called for water but could not drink it on account of choking feeling in throat; grasped throat with hands.

"Next morning (February 12) occasionally bright, then stupid; twitches and starts when trying to sleep. Took no liquid food, little toast. Bowels constipated. Convulsions became more severe and more often, until almost continuous. Child conscious and in great agony. Died at 6 A.M., Feb. 13, 1890."

TRICHINOSIS.

Fortunately this disease is of extremely rare occurrence among human beings in Massachusetts, and fatal cases from this cause are still more rare, but one death from this cause having been reported in the registration reports during the entire period of registration of forty-eight years.

Twice only during 1890 were cases reported to the Board, none of which proved fatal. The first case was that of a young man living in Stoneham, who, while on a visit to a relative in New Hampshire, a butcher, or dealer in meat, partook of some raw ham. Soon after returning to his home in Stoneham he was taken ill with the usual symptoms of trichinosis, and after an illness of three or four weeks recovered. None of the infected parts could be obtained for examination. It was reported that the butcher in New Hampshire, who also partook of the ham, was taken ill with similar symptoms.

The particulars of the other cases were as follows: —

A family in the town of Huntington consisted of eleven persons, French Canadians, a father, mother and nine children. Eight members of this family were taken ill between the first week of December, 1890, and the first of January, 1891. The symptoms were chiefly muscular pain and tenderness, diarrhœa, fever, rapid pulse and high temperature (104°), œdema of face and limbs, furred tongue; pain and soreness of the muscles were predominant symptoms. When visited by the secretary, January 8, the father, one son aged eighteen, and a daughter aged fifteen were in bed suffering severely. The mother and the younger children suffered the least. One child was away from home and was not attacked. Another child aged five, living at home, and a baby of three months were not ill, or at least had no apparent symptoms of trichinosis.

This family bought a pig in December, which was killed by a butcher in the village, who had sold them the pig. Its weight was about two hundred pounds, and it was about a year old. The butcher stated that another pig out of the same litter had "blind staggers," and was killed by its owner. The family ate freely of the pork, using it very abundantly through December. It was cooked in a variety of ways, being roasted, fried, boiled, and a portion was made into sausage meat. The mother stated that all which was eaten had been cooked, but portions did not appear to be thoroughly done. On examining the specimen of the muscular fibre from the diaphragm at the house, it was found to contain a large number of trichinæ, and on submitting a portion to Professor Mark of Cambridge, their presence was confirmed.

The recent act of Congress relative to the "inspection of meats for exportation, prohibiting the importation of adulterated articles of food or drink, and authorizing the president to make proclamation in certain cases, and for other purposes," and the "act to provide for the inspection of live cattle, hogs and their carcasses and products thereof, which are the subjects of interstate commerce, and for other purposes," have a direct bearing upon the question of trichinosis, and are quoted in full in that portion of this report which relates to food and drug inspection.

Public Institutions.

The only institution which has applied to the Board for its advice under the statutes during the year was the State Primary School at Monson. A request was received from the trustees of this institution "for the advice of the State Board of Health as to the best means of preventing the too frequent recurrence of diphtheria in the State Primary School."

This institution consists of a collection of wooden buildings situated in the town of Monson, upon the northerly side of a hilly slope about one mile from the Palmer station on the Boston and Albany Railroad. The institution was originally designed and built for a State almshouse, being one of the three structures erected for that purpose in 1854. It was used as such for about twenty years, and finally was converted into an institution for children. In addition to the old wooden building erected in 1854 there are a hospital for sick children and a comparatively new hospital designed for the reception of children who are ill with contagious diseases. The former is one story in height and the latter two stories, and has four small wards, quite well adapted for the purposes for which it was built. There are also several smaller wooden buildings, used chiefly as play-houses for the children.

The Population. — In addition to the superintendent and his family, the teachers and employees at the school, about 40 in number, the inmates consist of about 350 children of both sexes and of various ages, from twelve up to fifteen years. These children are mostly received from the families of State paupers either in other State institutions, principally from the State Almshouse at Tewksbury, or from the families of outdoor poor in the cities and towns of the State having been committed to the custody of the State by the courts. They come from a class of the general population which is especially liable to the occurrence and the propagation of infectious diseases, in consequence of their habits of life, such as overcrowding, the presence of filth, and general neglect of sanitary precautions. It is not, therefore, a matter of wonder that infectious diseases should occasionally be brought to a public institution by the individuals composing such a class, either in their persons, their clothing or their effects.

Among these children there were several cases of diphtheria during the year 1890, the first being three girls aged four, eight and eleven years. They lived in that part of the building occupied by the girls, two in the second story and the older in the third story, in the easterly end of the building. The first was taken ill February 10. They were all taken to the contagious hospital.

The apartments occupied by these children were old and worn, the floors loose and uneven and walls cracked in many places. The condition is usually neat. The room occupied by the smaller girls is 11 feet in height with a floor area of 36½ by 46⅔ feet, having 18,730 cubic feet of air-space or an average of 468 feet for each child when the number present is 40, and 375 feet when the number is 50. This is a fair allowance for children of this age, other conditions being good. The ventilation of this room is partly furnished by an upright cylindrical shaft leading from the top of the room to the roof, and by doors and windows. The room is heated by steam coils near its centre.

The third or attic story is next to the roof, its air-space running up to the rafters.

The disposal of the excreta is worthy of note. In the second story dormitory the water-closet is separated from the large room by a light partition only. The plumbing is boxed and out of sight, and if a leak should occur it could not be readily detected. In one of these closets a lead trap was removed in the spring and was found to be much corroded, but not to such an extent as to allow fluid contents to leak through.

In the third story dormitory there are no water-closets, the plan of disposal being effected by means of pails placed in small wooden closets ventilated into the flues or chimneys. These pails are emptied daily. The floors are of hard pine oiled. In the nursery they are of hard pine but not oiled.

The play-houses are on the hilly slope south of the building. One of these, used by the little children, is an old, one story building, once used for keeping fowls; its floors are old and much worn.

The water supply of the school comes from the reservoirs, one at the south, half way up the hill, and the other on the slope of the hill west of the school.

The south reservoir is reserved chiefly for fire protection, but supplies one out-door drinking fountain. The drinking water used in the main building is mostly supplied from the west reservoir. The superintendent's department can be connected with either supply. Drinking water for the superintendent's family is taken from a spring on the premises.

The drainage of the buildings is principally by means of a sewer which passes along the westerly side by the west end of the building, and thence down the hill to the river.

Prevalence of Diphtheria. — The institution has not suffered from this disease to a greater extent than has been common in a population of the same number and the same ages living under other conditions. Several cases occurred in 1882 and 1883 attended with five deaths, and since that time there have been but few cases till the present year. Cases entered upon the hospital records as tonsillitis, laryngitis, pharyngitis, sore throat and croup have been of frequent occurrence. An epidemic of tonsillitis appears to have prevailed quite generally in 1886–1887.

During the fortnight previous to the occurrence of the cases in February, 1890, five children were admitted from Boston and Springfield, two from the former on January 29, and three from the latter city on January 31. One of those from Springfield, aged three years ten months, was taken ill with tonsillitis February 10. Soon after the illness of these three girls in February, a teacher who had the supervision of these children was taken ill with diphtheria. The substitute who followed her also had sore throat, and from that date there were occasional cases of sore throat through April, May and the summer months, among the attendants as well as among the children. In April, a child aged six, who lived in the family of the painter, in a house near the school, was taken ill with diphtheria and died. This child attended school with the children of the same age, but did not sleep or eat at the school.

Another undoubted case occurred August 28, a colored boy, who came from the neighboring town of Monson. He was one of five children of one family, aged four, five, eight, eleven and thirteen, who came together and were admitted July 22. He and his sister of five years were put into the nursery ward, the same room in which the previous cases originated. Between the date of this boy's admission and the time of his being taken ill, twenty-five children were admitted, of which number five came from Boston, two from Springfield, one from Gloucester, one from Chelsea, one from Lynn, seven from small towns in different parts of the State, and eight from the State Almshouse at Tewksbury.

Summary. — There were during 1890 the following cases of diphtheria at the school: —

February, three; March, one; April, one; May, two; August, one; October, two. The first case was that of a girl from South Boston, who had been in the school a year. A previous case of tonsillitis had, however, been reported

February 10, a child of four years, who had come from Springfield ten days before being taken ill.

So far as could be determined from several visits, the centre of infection appears to have been the room in the second story east wing, occupied by little children from two to six years of age. In this room there were four cases, and of the remaining cases, occurring in the third story, the first was a sister of one of those taken ill in the second story. The boy ill in October was an inmate of the third story ward, but ate and played in the second story ward with the little children. Another, a girl in the third story, was employed a part of the time in the second story ward. The location of the beds of the infected children was not such as to give rise to suspicion of infection from bed to bed.

In the opinion of the secretary, the infection of diphtheria was introduced into the school from without, about January 31, or Feb. 1, 1890, and subsequent cases were probably the result of that importation of the disease. There may have been a re-importation in August. The nursery ward probably became to a greater or less extent infected with the contagion of diphtheria. The age and condition of the room, its walls and floor are such as to favor the retention of infectious material. Its population consisted of 40 or 50 children from two to six years old, the age above all others which is most susceptible to this disease. Possibly the small play-house in the yard may have contributed to the infection.

With these facts in view the Board addressed the following reply to the trustees of the State Primary School: —

Office of State Board of Health,
13 Beacon St., Boston, October, 1890.

To the Trustees of the State Primary School.

Gentlemen: — In reply to your letter of Sept. 12, 1890, requesting the advice of the State Board of Health as to the best means of preventing the too frequent occurrence of diphtheria at the State Primary School, I have the honor to state that the matter has been submitted to the Board, and in compliance with the request, several visits have been made to the school for the purpose of ascertaining the conditions under which diphtheria has prevailed there.

Cases occurred in February, March, April, May, August and October, 1890, in the school and its immediate neighborhood, one case having occurred in the family of a painter living but a short distance outside the yard. This child attended school during the day in the institution.

These cases point very strongly and significantly to the second story ward, occupied by the little children from two to five years of age, as the centre of infection. Some four or five cases have occurred among children occupying this ward and among those who were taken ill in the third story wards. One was a boy who eats and plays in the second story ward with the little children, and another, the last one taken ill, is that of a girl who is employed in the daytime in the second story ward occupied by the little children.

In reviewing the history of the school for the past ten years we find that there have been eleven deaths from diphtheria and croup, as follows : —

In October, 1880, one girl of six years.

In April, 1881, one boy of six years.

In November, 1882, one girl of three and a half years.

In December, 1882, one girl of six years and eight months; one boy of three and a half years; two girls of —— years; one boy of five and a half years; one boy of seven years.

In March, 1885, one boy of one year.

In April, 1890, a boy of six years at painter's house outside the yard; attended day school only.

These eleven cases, or about one death annually, are all of the recorded deaths from diphtheria and croup which have occurred in ten years. Compare this with the total population outside the institution; there were in Massachusetts for the same period, 1880–1889, 17,550 deaths from diphtheria and croup among 476,000 children between the ages of 0 to 16 years, a ratio of 3.7 deaths per thousand of the people annually of that period of life, which was greater than the mortality at the school. In connection with these cases, however, the following comment should be made : —

Between July, 1884, and Oct. 1, 1890, out of 2,493 admissions to the hospital of the institution, from all causes, there were recorded 371 cases from the following causes combined : diphtheria, tonsillitis, and follicular tonsillitis, pharyngitis, laryngitis, sore throat and swollen tonsils, or 14.9 per cent. of the whole number of admissions, of which 14 only, or but little more than half of one per cent., were determined to be diphtheria.

In view of the extreme uncertainty which attends the diagnosis of mild cases of diphtheria, from the other diseases named in this list, it is quite possible that at least some of these cases may have been mild and unrecognized cases of diphtheria.

For the purpose, first, of preventing the introduction of diphtheria from without, and secondly, to prevent its spread if once introduced into the school, the Board would make the following recommendations: —

That measures of a quarantine character should be adopted with reference to all children committed to the school, especially those coming from districts in which any infectious disease of a dangerous character is known to be prevailing. Care should be taken to make inquiry as to the prevalence of such disease during the previous month in the city or town, institution or family from which the child is admitted.

A medical examination, to include a special examination of the throat, should be required on the admission of each child, and any suspicious case, or one found to be infected with any contagious disease, should be isolated. Such measures can now be carried out, since the institution has a resident physician. The attention of the trustees is respectfully called in this connection to the following extract from the fourth report of the State Board of Health, Lunacy and Charity, 1882, page cxxxv: "All children, as they come into the establishment, will be isolated for a while, until it is ascertained whether they are affected with any contagious disease."

For the further prevention of the introduction of infectious disease, the admission of visitors, especially the relatives and friends of children (coming as they do from a class unusually liable to the occurrence of infectious diseases), should be allowed only under careful supervision.

For the prevention of the spread of diphtheria and other infectious diseases, after they have been introduced from without, the wards in the second and third stories of the east end of the building should receive a thorough cleansing and disinfection, measures which cannot well be adopted during their occupancy and could also be carried out with much greater efficiency under improved methods of construction and arrangement.

As an additional precaution it is recommended that the heads of all children coming from the infectious hospital should be shaved and the hair destroyed by burning, and the clothing used there be scalded in a solution of bichloride of mercury, 1 to 1,000. The beds in the dormitories should each be marked with a permanent number, for the purpose of identification of each child. Finally the small play-house at the east end of the yard should be destroyed, and a new one erected in a new location.

REGISTRATION OF VITAL STATISTICS.

In accordance with previous custom a brief digest is herewith presented of the Vital Statistics of the State for the year 1889, which were edited by the secretary of the Board.

Population.

The estimated population of the State for the year 1889 was 2,175,153.

Births.

The number of births in the year 1889 was 57,075, the largest number recorded in one year since the beginning of registration. This number represented a ratio or birth rate of 26.24 per 1,000 of the living population. The number of still-births was 2,021.

The birth rate of the twenty-eight cities was 28.77 per 1,000, and that of the remainder of the State was 22.31 per 1,000. The largest number of births in a single month in 1889 occurred in August and in the third quarter of the year, and the least number in February and in the first quarter. The sexes were distributed as follows: males, 29,017; females, 28,042; not stated, 16.

Marriages.

The number of marriages in 1889 was 20,397, and was greater than that of any previous year. The marriage rate (persons married) was 18.76 per 1,000, and the number of marriages was 9.38 per 1,000 of the living population. The ratio for the twenty-eight cities was 10.34 per 1,000 and for the rest of the State 7.88 per 1,000.

The greatest number was recorded in November and in the last quarter of the year, and the least number in March and in the first quarter.

Deaths.

The number of deaths registered in 1889 was 41,777, which was 320 less than those of the previous year, but was 2,738 more than the average of the five years ending with 1888. The death rate was 19.21 per 1,000 of the living population, which was less than that of any year except one since 1879. The mortality of infants under one year was 9,105, and the percentage of deaths of this class to the total mortality was 21.79. The mortality rate of the twenty-eight cities was 20.75 per 1,000, and that of the rest of the State was 16.81. The greatest number of deaths occurred in July and in the third quarter of the year, and the least number occurred in November and in the first quarter. Of the whole number of deaths 20,978 were males and 20,799 were females.

CAUSES OF DEATH.

The number of deaths from unknown or unspecified causes was 490, or 1.17 per cent. of the whole, a smaller ratio than that of any previous year.

From the class of diseases known as *zymotic* there were 8,034 deaths; from *constitutional* diseases, 9,000; from *local* diseases, 18,187; from *developmental* diseases, 4,373, and from *violence*, 1,693.

There were but four deaths from *small-pox* in 1889, and the annual average of the ten years ending with 1889 was 16.

The deaths from *dysentery* were 299, and the decennial average was 305.

The deaths from *typhoid fever* were 891, and the decennial average was 909. The ratio of deaths from this cause has gradually diminished from 7.6 per 10,000 of the population in 1860 to 4.1 per 10,000 in 1889. The highest ratio was 13.4 in 1865, and the lowest was 3.7 in 1879.

From *whooping-cough* there were 310 deaths in 1889, and an average of 250 for the decennial period.

From *diphtheria and croup* there were 2,214 deaths in 1889, and a decennial average of 1,857. The greatest number occurred in October and the least in July.

The deaths from *measles* were 171, as compared with a decennial average of 222. The mortality from this cause in 1889 was not distributed with uniformity throughout the State, since 84 per cent. of the deaths occurred in Bristol, Essex, Middlesex, Suffolk and Worcester counties, while there were no deaths from the same cause in Barnstable, Dukes, Hampshire and Nantucket counties.

The deaths from *scarlet-fever* were only 185, which was 319 less than those of the previous year, and also less than those of any previous year, except 1848, since the beginning of registration. There were no deaths from this cause in Barnstable, Dukes and Nantucket counties.

From *phthisis* the number of deaths was 5,581, while the decennial average was 5,801. The death rate from this most destructive of all causes has steadily diminished from 34.3 per 10,000 of the population in 1870 to 25.7 in 1889. In general the death rate from this cause is greater in the eastern counties of the State than in the western.

The deaths from *pneumonia* were 3,440, as compared with 3,716 in the previous year, and a decennial average of 3,147.

The deaths from *cholera infantum* were 2,156, which was 39 less than those of 1888, and 114 greater than the decennial average.

The number of deaths from the principal diseases of the *nervous* *system* (apoplexy, paralysis, insanity and convulsions) was 3,466, as compared with 3,561 in 1888, and a decennial average of 2,995.

The deaths ascribed to *insanity* were 214, which was higher than that of any previous year, the decennial average being 167.

There was a notable increase in the deaths from *heart diseases* during the ten years, the number registered from this cause in 1880 being 1,822, and increasing with considerable uniformity to 3,280 in 1889.

There was also a marked increase in the deaths from *kidney diseases*, from 723 in 1880 to 1,290 in 1889.

There was an increase in the deaths from *hydrophobia*, the number in 1888 being 2, and in 1889, 14; while in the six preceding years there had been no deaths from this cause.

MEDICAL EXAMINERS' RETURNS.

The number of deaths which were investigated by the medical examiners in 1889 was 1,654. These were the deaths from violent, sudden and suspicious causes, which were referred to these officers during the year for the purpose of official inquiry.

Of this number 1,253 were males, 388 were females and the sex of 13 was not specified. The deaths from homicide were 51; from suicide, 199; from accident, 792; and from all other causes, 612. The principal accidental causes were: by drowning, 244; by railroad accidents, 252; by falls and blows, 134; and by burns, scalds and explosions, 42. There were 238 deaths investigated, in which intemperance was alleged to have been either the direct or indirect cause.

WEEKLY MORTALITY REPORTS.

Early in the history of the Board a system of collecting and of diffusing information upon the health of the State was begun by obtaining from each local authority in the cities and towns, so far as could be done by means of voluntary reports, a weekly return of the deaths in such cities and towns. This practice has been continued to the present time, and has proved a useful aid in the investigation of the causes and prevalence of disease, especially of the infectious and the preventible classes. In the past seven years these have been published in the form of a weekly bulletin, and sent to each city and town. As this system of weekly returns of deaths is very imperfect as now conducted, in consequence of the failure of many of the cities and large towns to make such returns, it is desirable that measures should be taken by adequate legislation to secure uniformity of practice in this respect throughout the State, at least for the cities and large towns.

In 1888 a six years' summary was presented, with a series of charts, in which the seasonal prevalence of the principal infectious diseases was graphically presented by means of diagrams illustrating the numbers of deaths from each principal cause for each week for the year 1888, and for the six-year period, 1883-1888.

FOOD AND DRUG INSPECTION.

The operations of the Board under the food and drug acts of 1882, and the amendments of later years, have continued without interruption throughout the year. Three inspectors have been constantly employed in the collection of samples in different parts of the State, and these have been submitted to the chemists for analysis. The publication of a monthly bulletin, begun in 1889, has been continued uninterruptedly from that time. This bulletin has been published in the same sheet with the regular mortality reports of the Board, and has been sent regularly to each local board of health in the State. It has proved a useful mode of diffusing information upon the subject of food adulteration among the people. The material presented in these bulletins consists of a summary of the articles examined by the chemists of the Board in each month, a statement of the number and character of the complaints entered in court, a list of the towns visited by the inspectors, and such other information relative to special and new forms of adulteration as may have come to the knowledge of the Board during the previous month.

The whole number of samples examined by the chemists during the year was 5,985. During the entire period of seven years or more since the enactment of the present law, 35,671 samples have been submitted for analysis.

The work of the Board in this direction has secured to the people of the State a purer and better food supply, and the gain which has thus been acquired has far more than counterbalanced the outlay which has been made.

A summary of the prosecutions and an account of the expenses of the Board in carrying out the provisions of these statutes was sent to the Legislature, in compliance with the terms of the act, in February last (Senate Document 80).

Noxious and Offensive Trades.

Under the statute giving authority to the Board to act upon application of parties complaining of certain trades or occupations which cause " nuisance or are hurtful to the inhabitants, or dangerous to the public health, or the exercise of which is attended by noisome and injurious odors, or are otherwise injurious to their estates," no applications have been made to the Board during the year.

In the only case which was referred to the Board during the previous year, the factory at Dighton in which paris green was manufactured, appliances were used to prevent annoyance and injury from the escape of the dust, and no further complaints have been received in regard to it.

Local Boards of Health.

The legal status of boards of health in the towns in Massachusetts is unfortunately of such a nature as in many instances to entirely defeat the proper administration of sanitary laws in the towns. Much evidence has accumulated in the office of the State Board of Health showing the urgent need of adequate legislation which shall afford a proper sanitary board for every town, or at least for all the large towns in the State.

The necessity of such legislation has already been alluded to in previous reports of the Board, especially in the twentieth annual report, in which instances were cited showing the inadequacy of the present law to meet the requirements of public health. It is not necessary, therefore, to dwell at length upon the subject in this report. It is sufficient to say that the need of a better law becomes more apparent every year.

Water Supply and Sewerage.

This important department of public sanitary work is conducted by the Board under the provisions of the " Act to protect the purity of inland waters." (Chapter 375 of the Acts of 1888.)

A portion of this work, comprising the advice of the Board to the authorities of cities, towns and individuals, has already been published as Senate Document No. 4, 1891, and forms the first part of the present report, pp. 1–66.

The two volumes referred to in the last report (p. ix) have been published since the date of that report, and are entitled: "*Examination of Water Supplies and Rivers*" (vol. I.), and "*Purification of Sewage and Water*" (vol. II.). These two very full and complete reports contain the results of the work of the Board for the years 1887, 1888 and 1889 upon these important subjects. In the present report an additional account of the work done in the examination of water supplies up to Dec. 31, 1890, is also presented.

The entire work in this department has been conducted under the general supervision of the committee of the Board upon Water Supply and Sewerage, of which Mr. Mills is chairman.

The chemical examinations of waters have been conducted, as in previous years, at the laboratory of the Institute of Technology, under the direction of Prof. T. M. Drown, and the biological examinations have been made under the direction of Prof. W. T. Sedgwick.

The Experiment Station at Lawrence, established in 1887, for the purpose of experimental work upon the purification of water and sewage, is under the direct supervision of Mr. Mills. A description of the station may be found in the special volume upon "Purification of Sewage and Water." A new laboratory was built and equipped during the past year at a moderate cost, having two conveniently arranged rooms for chemical and biological work. In the same line of work, the chief engineer of the Board has contributed to this portion of the present report a paper upon the "Selection of Sources of Water Supply," which will prove valuable to all who are looking to new regions for supplies of water in sufficient quantity and of good quality.

Typhoid Fever in its relation to Water Supplies.

It has been pretty conclusively demonstrated during the past twenty years or more that supplies of water for domestic purposes, either private or public, have proved to be the media through which the specific infection of typhoid fever has spread from the sick to the well, thus carrying the disease sometimes to single families, and sometimes to large communities.

The excessive prevalence of the disease during the years 1889 and 1890 in some of the larger cities of the State has afforded opportunity to investigate the subject so far as it relates to supplies of drinking water, and a paper is contributed to this report by H. F. Mills, C.E., a member of the Board, in which the question is considered in its relation to such supplies of drinking water.

THE GROWTH OF CHILDREN.

Professor Bowditch's observations upon the Laws of Human Growth are continued in the present report, to which he has contributed a valuable paper upon "The Growth of Children studied by Galton's Method of Percentile Grades."

HEALTH OF TOWNS.

A digest is presented of the principal and important points contained in the reports of local boards of health which have been forwarded to the office of the State Board. These comprise the reports of 20 cities and 32 of the larger towns. Very many of the towns, especially those which are of small size and have an almost stationary population, have no board of health other than the board of selectmen, and publish no report of their transactions.

RECOMMENDATIONS.

The Board renews its recommendation expressed in previous reports, that the present law allowing a town to impose the duties of the local board of health upon the selectmen should be made permissive only in the smaller towns.

It is also recommended that the weekly returns of mortality which are now sent to the State Board by the local boards of health be required by legal enactment, as applied to all cities and large towns. These returns have proved especially valuable in tracing the course and causes of epidemics with reference to their future prevention.

EXPENDITURES.

The expenses of the Board during the year ending Sept. 30, 1890, under the three appropriations for General Expenses, Food and Drug Inspection, and Water Supply and Sewerage work, are herewith presented: —

General Expenses.

Salaries,	$5,113 00
Printing,	1,500 59
Apparatus,	970 88
Travelling,	785 51
Books,	205 45
Special investigations,	410 28
Stationery,	213 78
Postage,	228 46
Chemical analysis,	125 00
Map of the State,	105 00
Telephone,	95 05
Office incidentals,	54 89
Bookbinding,	23 20
Advertising,	16 25
Express,	15 92
Telegrams,	7 75
Total,	$9,871 01

Food and Drug Inspection.

Salaries of chemists,	$4,700 00
Salaries of inspectors,	3,187 50
Travelling expenses and purchase of samples,	1,998 75
Legal services,	168 00
Bottles, corks, twine, seals and other incidentals,	58 14
Total,	$10,112 39

Water Supply and Sewerage.

Salaries,	$16,909 78
Experiment Station at Lawrence (labor, rent and materials),	5,708 89
Rent of Massachusetts Institute of Technology,	1,062 50
Travelling,	470 92
Express and postage,	597 27
Photo-micrographs,	175 00
Apparatus,	173 75
Maps, blue-prints and stationery,	37 85
Paid observer,	25 50
Total,	$25,161 46

HENRY P. WALCOTT,
JULIUS H. APPLETON,
ELIJAH U. JONES,
JOSEPH W. HASTINGS,
HIRAM F. MILLS,
FRANK W. DRAPER,
JOHN M. RAYMOND,

State Board of Health.

WATER SUPPLY AND SEWERAGE.

WATER SUPPLY AND SEWERAGE.

The State Board of Health is required, by the provisions of section 3 of chapter 375 of the Acts of 1888, "to consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply, drainage or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their drainage or sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. It shall also from time to time consult with and advise persons or corporations engaged or intending to engage in any manufacturing or other business, drainage or sewage from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal or purification of such drainage or sewage: *provided*, that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. All such authorities, corporations, firms and individuals are hereby required to give notice to said board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and sewage; *and all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said board thereon.*"

Under this act the following cities, towns, corporations and individuals, have applied to the Board for its advice, since the date of the last report (Senate Document 4, Jan. 10, 1890.)

Applications for advice relating to water supply were received from the following sources and answers were sent to them as follows: The Cottage City Water Company; the Dracut Water Supply Company; the trustees of the Massachusetts School for the Feeble-minded; citizens of Rockport; the trustees of the State Normal School at Framingham; Plymouth; J. C. Whitney, Esq., relative to the Hyde Park Water Company; the superintendent of the Woman's Reformatory at Sherborn; Easthampton, Webster and Manchester. In addition to the foregoing, replies were also sent to the authorities of Ipswich, Southborough, to citizens of Foxborough, to the commissioners of the Foxborough water supply district, the Stockbridge Water Company, and the water commissioners of Springfield, in answer to applications which had been received by the Board from these parties during the month of December, 1889. Those which related to sewerage and sewage disposal were from Quincy, Pittsfield, Gloucester, Westborough, Brockton, Revere, Lexington, Whitman, Erving, Winthrop, the Board of Health of Worcester, relative to the sewage disposal of the State Lunatic Hospital at Worcester, Bradford, the Brookline Gas Company, Framingham, Athol and Beverly.

WATER SUPPLY.

The following is the substance of the action of the Board in reply to applications for advice relative to water supply: —

IPSWICH. The water committee of the town of Ipswich applied to the Board (Nov. 30, 1889) for its advice relative to water supply, suggesting Dow's Brook, Egypt River and Ipswich River as sources. The Board replied as follows: —

BOSTON, Jan. 11, 1890.

The three sources named in your application, viz., Dow's Brook and Egypt and Ipswich rivers, have been examined, and a sample of water from each of these sources has been analyzed. The waters of both rivers are so much affected by having stood in swamps that they are not of satisfactory quality for a domestic water supply. The water of Dow's Brook is at present colorless, soft, and in other respects a very good surface water. If stored in a somewhat shallow storage reservoir, as proposed, the water will undoubtedly deteriorate to some extent, and may be seriously affected by disagreeable tastes and odors such as have occurred in many reservoirs in the State. From the information furnished by you, and such additional information as could be obtained, it is not probable that Dow's Brook would furnish, in a very dry year, enough water to supply the present population after the water had come into general use.

In choosing a source of water supply, it is obviously of the utmost importance to the town that the quality of the water selected should be good, and that there should be no doubt as regards the sufficiency of the supply. As none of these sources mentioned fully meet these requirements, the Board advises that further investigations should be made to ascertain if a better source than any of those mentioned cannot be found, and suggests as sources to be examined a supply from the ground near either the Ipswich River above the town, or Miles River; also the latter river, with a view of taking its waters directly from the stream. If a supply can be obtained from the ground at either of the places named, it will be of better quality than that from any surface source. The water of Miles River is of better quality than that of either the Ipswich or Egypt rivers, though inferior to that of Dow's Brook in its present condition. The water of Dow's Brook after storage may be even less satisfactory than water taken directly from Miles River. Water obtained from the ground should be stored in a reservoir where it will not be exposed to the light.

SOUTHBOROUGH. The committee on water supply of the town of Southborough applied to the Board for its advice relative to an appropriate source of water supply, and the Board replied as follows: —

BOSTON, Jan. 7, 1890.

The State Board of Health has considered your application, dated Dec. 4, 1889, for advice in regard to the most appropriate source of water supply for Southborough, and herewith presents its reply: —

The sample of water from the driven test well between the Worcester Turnpike and Stony Brook, west of Fayville, was of satisfactory quality. As regards quantity, it is not improbable that a sufficient supply of water might be obtained from a large well at this place; but the indications are not such as to prevent some uncertainty as to the result. The Board therefore advises that further examinations be made, before works are constructed, to ascertain if some suitable place for a well cannot be found near some other portion of Stony Brook, where the underlying material is coarse sand or gravel over a larger area. It is not probable that Marshall's Spring and Brook will furnish a sufficient quantity of water.

FOXBOROUGH. Citizens of Foxborough presented to the Board an application, dated Dec. 6, 1889, for its advice relative to the following means of supply, as appropriate for a public water supply: —

1. Springs about one-fourth mile distant from, and almost directly in front of, the house of Peter Post, on Mechanic Street in said Foxborough.

2. Springs on land of William T. Cook, near line of Old Colony Railroad, and located a short distance northerly from Chestnut Street in said Foxborough.

3. Governor's Brook, so called, near Carpenter's Mill, Lakeview, Foxborough.

4. Any springs, natural ponds, brooks or other water sources within the limits of the town of Foxborough.

To this application the Board made the following reply: —

BOSTON, Jan. 8, 1890.

The springs opposite the house of Peter Post, on Mechanic Street, will furnish a soft water of excellent quality, and the quantity of water that could be obtained from a large well suitably located in the vicinity of the springs, probably at some point below them, would be large. The ground in this vicinity appears to be a coarse, porous gravel, which would permit the water to flow freely into the well; and the only serious doubt which remains as to the suitability of this source for supplying the water supply district of Foxborough, is in regard to exhausting the supply by a continuous draft upon it. The amount of water which a well or wells in this vicinity will furnish is equal to the rainfall upon the area contributing to the well, less the amount that goes off by evaporation, and the amount which flows off over the surface. It is practicable, in some directions from the spring, to determine approximately, by surveys and levels, the area from which the ground water would flow towards a well; and in other directions, as, for instance, towards the reservoir, to form a fair judgment as to the area which would contribute to the well when the water in it is lowered by pumping. The prospect for obtaining a sufficient supply from this location appears to be favorable, and the Board advises that investigations be made to determine if a well here will furnish a sufficient quantity of water; and, if this should prove to be the case, would advise this as the most appropriate source for supplying Foxborough with water.

The water in Carpenter's Mill-pond, on Governor's Brook at Lakeview, is inferior in quality for the purposes of a public water supply to that from the springs, and it is obvious that water from this brook below the wool-scouring mill at this place would be objectionable in quality.

A well or filter gallery near the brook at some point below the wool-scouring mill might furnish a sufficient supply for the district, a part of the water being derived from the land side and a part by filtration from the brook. Water derived from the brook in this way would probably be of satisfactory quality, if the well were located not less than one hundred feet from the brook. This source appears less favorable than the springs first mentioned, and the Board does not advise its further consideration unless the quantity to be obtained from the springs should appear, after investigation, to be insufficient. The springs on land of W. T. Cook did not give promise of as large a supply as those opposite the house of Peter Post. Other sources near the village were looked at, and plans have been examined, but the Board has not learned of another source as good as those already mentioned.

The commissioners of the water supply district of Foxborough also applied to the Board (Dec. 20, 1889) for its advice in relation to a proposed system of water supply, and at the same time designated the springs opposite the house of Peter Post, on Mechanic Street, as an appropriate source of supply. To this application the Board (Feb. 18, 1890) presented, without modification, the same advice which had been given previously to citizens of Foxborough (presented in full on the foregoing page).

THE STOCKBRIDGE WATER COMPANY. The Stockbridge Water Company applied to the Board (Dec. 7, 1889) for advice relative to an additional supply of water from Konkapot Brook, and also from one of its tributaries flowing from Lake Agawam, to which the Board gave the following reply: —

BOSTON, Jan. 8, 1890.

Analyses of water from both of these streams, made in December, 1889, showed that both were at this time suitable for domestic use; but the water from Konkapot Brook was decidedly better for drinking and all domestic purposes than that from the stream flowing from Lake Agawam. It would be an advantage, as regards quality, to take water from Konkapot Brook above the confluence with the brook from Lake Agawam. A pumping station at the confluence of the two brooks, so arranged as to draw water from either of them, at will, would be desirable if Konkapot Brook is liable to become muddy after heavy rains.

It is evident that the old four-inch pipe is too small to give a satisfactory head in the village. The Board therefore suggest that, as the present pipe will have to be supplemented by one of larger capacity in the future, the proposed pumping main should be put in as large as six inches in diameter.

SPRINGFIELD. After the report of the Board, which was made in September, 1889, relative to the question of improving the quality of the water of the Springfield water supply, the water commissioners of Springfield submitted to the State Board of Health an application for its advice, accompanied with a statement of certain proposed changes in their system of water supply, which, briefly stated, were as follows : —

The separation from the Ludlow reservoir of a portion thereof, having an area of about twelve acres, and a storage capacity of fifty million gallons; the connection of this smaller reservoir with the Broad Brook canal, by means of a pipe and open canal running outside the larger portion of the reservoir, and along the Cherry valley outlet and dam. Into Broad Brook canal the waters of Jabish Brook, rising in Pelham and Belchertown, were to be conducted as an additional supply. The water of the large reservoir was to be reserved to be used only in case of emergency. It was also contemplated to take the waters of Five Mile Pond, and conduct them to the Van Horn Reservoir, or to the main pipes as a further additional supply.

To this application the Board made the following reply : —

Boston, Jan. 29, 1890.

If the canals leading water from Jabish, Broad and Higher brooks are made so that their banks and beds are impervious, so that no water is wasted on the way between the natural channels of those brooks and the receiving reservoir, and the dam on Jabish Brook at the upper end of the canal be made so that no waste occurs there, these sources will, in wet years, supply as much water as Springfield will need in the immediate future; and its quality is likely to be as good throughout such years as the present supply from Ludlow Reservoir is during the months when it has not contained the offensive vegetable growths. But, during dry years, sufficient water will not be supplied from these sources. In a year as dry as our last dry year, 1883, measurements of water supplied by streams in the eastern part of the State indicate that, with the proposed receiving reservoir full on the first of July, it would have been emptied by the last day of September, if 2,500,000 gallons had been drawn daily. If, on the other hand, the canals leading from the natural courses of these brooks to the receiving reservoir allow water to leak out of them, as we understand has been the case with the canal from Higher Brook to the reservoir, the quantity that will be available may be much less than the 2,500,000 gallons per day above given.

The quantity of 4,000,000 gallons per day, as given in the last report of the water commissioners, as about the quantity consumed in the city, is certainly none too large as a basis for a proposed supply for the immediate future. If 300,000 gallons per day can be received from Van Horn and Lombard reservoirs, there are 3,700,000 gallons to be furnished. To supply the difference between 3,700,000 gallons and 2,500,000, or a less amount, either Ludlow Reservoir must be drawn upon in the season when its water is likely to be the most objectionable, or another source that will supply 1,200,000 gallons or more, must be found. Five Mile Pond and its vicinity is suggested in your application as an additional source. From the data thus far obtained by the Board it appears that, if this pond were tapped at a depth of twenty feet below the surface, it might furnish 750,000 gallons a day. The quality of the water is at present good. Estimates of cost would be necessary before deciding that this is the best place to obtain the amount of water that it will furnish.

From the investigations made by the chief engineer of the Board, we are led to recommend that you have investigations made to ascertain if a ground water supply for the whole city cannot be obtained from the valley of the north branch of Mill River, and from the ground near the streams and ponds north of Mill River, including Five Mile Pond, supplemented, if necessary, with water from the Ludlow Reservoir, filtered through the sandy land in the vicinity, as suggested in the previous report of the Board.

COTTAGE CITY. The committee on water supply of Cottage City having applied for the advice of the Board relative to Beach Grove Mineral Springs and other springs in their immediate vicinity as a source of water supply, the Board, having caused an examination of the premises and of the water to be made on January 28, approved of the source presented.

THE DRACUT WATER SUPPLY COMPANY. Application was made by the Dracut Water Supply Company for the advice of the Board relative to taking the water of Tyng's Pond or Long Pond as a water supply for the town of Dracut, to which the Board made the following reply: —

BOSTON, Feb. 4, 1890.

The waters of these ponds are of good quality for surface waters, and either of the ponds will supply a sufficient quantity for the town for many years. They are three miles or a little more from Dracut village, and the expense of bringing the water from either of them will be considerable. Pumping will be required. Before going to the expense of bringing water so far, the Board would advise you to have examinations made, to see if an abundant ground water supply may not be obtained, nearer, at less expense.

THE MASSACHUSETTS SCHOOL FOR THE FEEBLE-MINDED. The trustees of this school applied to the Board (Feb. 3,

1890) for its advice relative to a water supply for the newly erected institution, situated in the easterly part of Waltham. The Board (on April 2) replied to the application as follows: —

The following brooks flowing in or near the estate of the school and the valleys containing them were examined: —

1. The brook which forms the boundary between this estate and that of the Warren heirs near Quince Street, and further up, wholly in the Warren estate, a short distance from your south-westerly boundary.

2. The brook which flows southerly into the estate of the school, about three hundred feet easterly from the custodial ward.

3. The small brook nearly parallel with, and about two hundred feet southerly from, North Street.

Water taken from the ground by a well sunk near either of these brooks would probably be of satisfactory quality, if not polluted by sewage from the institution. Water taken directly from the brooks would not be in any case as satisfactory in quality as if taken from the ground; and in the case of brook No. 2, the quality would probably be very unsatisfactory much of the year.

A well located within the school estate, near brook No. 1, between Quince Street and the farm-house, or outside of the estate, near this brook, not further up than the present spring, would probably furnish a sufficient quantity of water for the whole institution throughout the year; but these localities are no longer eligible, as the water would now be polluted by the effluent from the existing sewage-disposal area. Still further up this brook, beyond the reach of pollution, or near the other brooks, no very favorable location for a well was found. There appears, however, to be a fair prospect that a large well sunk beside brook No. 1, at some point above the disposal area, or beside brook No. 2, near the boundary of the school estate, would furnish a large quantity of water, if the character of the ground is favorable. It is probable that a better location for a well near brook No. 2 might be found further up stream, where the valley is wider. A well near brook No. 3 will not furnish a large quantity of water, on account of the limited size of the valley above it, the somewhat impervious character of the ground in which the well would be sunk, and the rapid descent of the valley below the proposed site of the well.

In the absence of information which might be obtained by sinking test wells, the Board is unable to give more definite advice as to the quantity of water which may be derived from these sources; and, while there appears to be no reason to anticipate that water derived from wells not polluted by sewage from the institution will be of objectionable quality, it will be well to have samples from the test wells analyzed before deciding to obtain a supply from any particular locality.

ROCKPORT. Citizens of Rockport having designated Cape Pond in that town as an appropriate means of supply for the town, and having applied to the Board (March 18, 1890) for its advice relative to the same, the Board replied as follows: —

BOSTON, March 26, 1890.

The Board has caused samples of water to be taken from the pond and has had them submitted to chemical and microscopal examination. The water at the present time is not found by either examination to be of satisfactory quality. It contained an unusually large number of organisms, and is therefore specially liable to bad tastes and odors, such as have affected many water supplies in the State. It is also shown by analysis to contain a large amount of ammonia, which indicates the presence of decaying matter. It is not feasible to tell whether the water at the present time is better or worse than at other seasons of the year; but, as a rule, the quality of the water of ponds is worse in the summer.

In view of this unsatisfactory condition of the water, the Board cannot at the present time advise that this pond will be a desirable source of supply for the town of Rockport, unless the water supplied is first efficiently filtered. If it should be found by subsequent examinations that the water of this pond is better at other seasons of the year than at the present time, the Board might have occasion to modify the advice above given.

THE STATE NORMAL SCHOOL AT FRAMINGHAM. The Board of Visitors of the State Normal School at Framingham requested the opinion of the Board (Jan. 5, 1890) as to the quality of the drinking waters used at the school, including the water taken from a well near the Sudbury River, and delivered by means of a windmill pump, and the waters of certain wells upon the hill near the school. To this request the Board replied as follows: —

BOSTON, Jan. 29, 1890.

The waters of both wells are well filtered, and, chemically considered, contain very little organic matter; but that from the well near Normal Hall has since last July increased in chlorine from 1.40 parts per 100,000 to 3.30 parts, indicating that, unless salt has been added to the water in some way that would be likely to be known to your management, the water is now filtered from a much greater proportion of sewage than it was six months ago. This water cannot be recommended for drinking.

The water taken from the windmill pump shows but a slight increase in chlorine in six months; viz., 0.41 parts to 0.51 parts. This increase is so small that it may not indicate anything, and it may indicate the beginning of the effect of sewage applied to the sewage-disposal field above the wells. The time is rather short for an effect to be produced, and, if produced, it will be much more marked in the dry season, when there is less water in the ground, and the well draws its supply from a larger area.

The water from the pump at the house of the engineer, near the sewage field, indicates some previous pollution, which has been well filtered out, the chlorine being at 0.83 parts.

On April 8 the Board of Visitors requested information as to the quality of the water furnished by the Framingham Water Company as a source of supply for the school, to which request the Board made the following reply: —

Boston, April 14, 1890.

Recent analyses of water from the works of the Framingham Water Company show that its quality is better than that of the Boston supply, and may properly be called good; but it was not so good as the water from the windmill well of the Framingham Normal School when examined in January last. The latter, as then stated, showed a slight increase in chlorine over the analysis of the previous August, but it could not be told whether this was from sewage pollution, or not. It was too soon to expect such pollution, and it might come later. If that slight increase in chlorine was due to such pollution, it does not indicate so much pollution as the analyses of the Framingham water supply The quality that water from the well and from the Framingham water supply is likely to have in the near future, can better be determined when this long wet period, which has now extended over several years gives place to a dry season; and, if the proposition to take Framingham water is merely to replace that of the windmill well, it would be advisable to wait a few months, and then determine by analysis which is the better.

The Board of Visitors then (April 18, 1890) inquired whether a driven well upon the hill near the Normal Hall building would furnish a satisfactory supply for the school; and if, in the judgment of the State Board of Health, it would not be likely to prove a sufficient supply of good quality, the Board was asked to state whether the water from the windmill well or that of the Framingham Water Company would be the better for the use of the school. The Board replied as follows: —

Boston, May 6, 1890.

The State Board of Health is of opinion that the improbability that a sufficient supply of water can be obtained in the hill near the school buildings is so great that it would not advise any expenditure there for the purpose. An analysis of water from the windmill well, made in April, 1890, shows a slight increase in the indication that filtered sewage reaches this well, though it is still better than the water of the Framingham Water Company. Before making arrangements for a future supply from the latter company, the Board would advise an investigation of an independent ground-water source from land of the city of Boston near the Sudbury River, one thousand feet or more above the railroad, and one from land of T. L. Barber, east of the school and near the pond. The former source would be preferable, if the cost were nearly the same. Estimates should be made on works large enough to supply all the water required for the school.

PLYMOUTH. The immediate neighborhood of the principal ponds used by the town of Plymouth for domestic water supply having become occupied by a few residents as a place of resort during a few weeks in the summer season, and cottages having been erected upon the shores of the ponds, the Water Board applied to the State Board of Health for its advice (Aug. 4, 1890) as to the best method of protecting the ponds from such pollution as appeared to be imminent from certain cottages situated near the shore. The State Board replied as follows: —

BOSTON, Sept. 15, 1890.

Privies located within one hundred feet of high-water mark should be dry earth closets. The essential features of such a closet are a movable water-tight receptacle under each seat, and the application of about a quart of dry soil each time the privy is used. The details may be varied, but satisfactory results can be obtained with the following arrangements: half of an oil cask may be used for the water-tight receptacle, and it should be placed wholly aboveground, preferably on a shelf about the height of a wheelbarrow, to facilitate removal. In the privy there should be a box to hold two bushels of dry soil, and a scoop for applying it. The seat should be so arranged that it can be lifted to avoid soiling it when the earth is thrown in. If proper care is exercised, the contents of the receptacle will be inoffensive, and may be disposed of by burying them in the sand not less than one hundred feet from high-water mark.

Stable manure should not be thrown out within one hundred feet of the pond upon ground which slopes towards the water; and, where this condition exists at present, the ground should be regraded so that polluting matters of this kind cannot be washed over the surface into the ponds. The manure piles should be removed as often as once a month while the stables are in use.

When the season for using the cottages is over, all polluting matter at the privy and stables should be removed before freezing weather. Sink water and house slops may be discharged into cesspools, or they may be turned into furrows in the ground. If the latter method is adopted, the furrow in use should be abandoned and filled with earth whenever it becomes clogged so that the water is not readily absorbed, and the water should be turned into another. In any case the disposal should be effected as far from the pond as practicable.

If typhoid fever or other communicable disease should occur at any house in the vicinity of the ponds, special precautions should be taken to dispose of the infected wastes, under the direction of the local board of health.

In giving the above advice, the Board has had in mind the special conditions affecting this case; namely, the very short season during which cottages are occupied, and the favorable character of the ground with regard to filtration.

EASTHAMPTON. During the progress of an epidemic of diphtheria at Easthampton, citizens of the town and also the authorities of the town requested the opinion of the Board relative to the quality of the public water supply furnished to the town.

The Board replied as follows: —

BOSTON, Aug. 21, 1890.

The water of Williston Pond has been analyzed by the State Board of Health in each month for two years. These examinations show much variation in quality at different seasons of the year. These variations are such as are common in similar shallow reservoirs. The amount of pollution entering the pond is not unusual; but it is sufficient, with the other conditions, to cause the growth of algæ and other organisms that at times give to the water a very unpleasant taste, and therefore render it unfit for drinking, although it is not known to be contaminated with anything especially injurious to health. It is not probable that extending the pipe into the pond, as has been proposed, would improve the quality of the water pumped.

The water that has been examined from the new source of supply on the mountain side is of much better quality than that from Williston Pond; and, if this could be made the source of supply during the seasons when unpleasant taste prevails in the water of the pond, the year's supply would be much less objectionable.

WEBSTER. The committee on water supply of the town of Webster applied to the Board for its advice relative to an appropriate source of water supply for that town, at the same time indicating certain ponds as being worthy of the attention of the Board for its examination.

The Board replied to this application as follows: —

BOSTON, Nov. 5, 1890.

The State Board of Health, in response to your application of Sept. 26, 1890, has caused examinations to be made in a general way of all sources in the vicinity of Webster, and more particularly of Lake Chaubunagungamaug in Webster, and of Ramshorn or Gore Pond in Dudley. The water from the former source would require pumping, while from the latter source a supply may be obtained by gravity. This advantage, however, is probably more than offset by the greater first cost of works for obtaining a supply from the pond.

Analyses of the water from these two sources show that the water from the lake is nearly colorless and contains but a small amount of organic matter, while that from the pond is highly colored and contains much organic matter (mostly of vegetable origin). Analyses of the water of the lake were made monthly, from June, 1887, to May, 1888, and show that the quality of water varied but little from time to time. This fact and the favorable experience of the town in the use of this water for the past nine years indicate that it is less likely than most surface waters to be affected with bad tastes and odors.

The Board is therefore decidedly of the opinion that Lake Chaubunagungamaug is the most appropriate source of supply for the town of Webster. It is also of opinion that it is the most appropriate source of supply for portions of the town of Dudley, so that the town of Webster should not acquire exclusive rights to the waters of this lake.

MANCHESTER. The committee on water supply of the town of Manchester requested the advice of the Board relative to a proposed supply of water from the ground in the valley of Sawmill Brook in that town, to be pumped to a covered stand-pipe for distribution. The Board replied as follows: —

BOSTON, Nov. 8, 1890.

In response to your application of October 15 for advice in regard to a proposed water supply for the town of Manchester, the State Board of Health has considered two sources. One source is in the valley of Sawmill Brook above the village, where, to obtain a satisfactory supply, it would be necessary to take the water from the ground; the other is Gravelly Pond, where a supply of excellent surface water can probably be obtained. A good ground water is to be preferred to a good surface water, as it contains none of the minute organisms which grow in the latter and are liable at times to give the water a bad taste and odor. In the present case the well cannot be located so far from habitations that some of the nitrogenous products from them and from manured fields will not reach it. The analysis of the water from the flowing test well, however, shows that all of the organic matter has been oxidized before reaching it; and, if the permanent well is placed further up stream, so as to be as far from habitations as practicable, there is no reason to doubt that the water will remain as satisfactory in quality as that from Gravelly Pond.

With regard to the quantity of water to be obtained from a well or wells in the valley of Sawmill Brook, the investigations made up to the present time do not furnish results upon which definite conclusions can be based; but, from these investigations and an examination of the surrounding territory, the probability of obtaining a sufficient supply from this source is so great as to make it undesirable to go to the greater expense of obtaining water from Gravelly Pond.

If a supply taken from the ground should prove insufficient, it can be supplemented by water taken from Sawmill Brook, and filtered by means of suitable works so as to make it of satisfactory quality. The volume of water flowing in the brook will at all or very nearly all times be sufficient for the supply of the town.

SEWERAGE AND SEWAGE DISPOSAL.

The following cases related to sewerage and sewage disposal: —

QUINCY. The mayor of Quincy applied to the Board for its advice (June 11, 1890), relative to a system of sewerage and sewage disposal. The Board made the following reply: —

BOSTON, Feb. 19, 1890.

The Board, in 1888, considered the question of the sewerage of Quincy when the plan proposed by Mr. E. C. Clarke was presented to it, and on July 6, 1888, sent a reply to the town, giving its advice regarding the outlets for the territory then under consideration. It also stated, in response to a request for advice with regard to the disposal of the sewage at the end of Hough's Neck, that it did not advise this plan of disposal. The reason of such advice was that, in the judgment of the Board, the other outlets would for many years serve the portions of the city under consideration, without prejudice to its sanitary condition, at much less cost. For the distant future, beyond the time for which sewerage systems are usually designed for cities of fourteen thousand inhabitants, the disposal of the sewage of this city into deep water off Nut Island would be eminently satisfactory, and this is probably the best site that can be selected. The outlet into deep water off Gull Point will dispose of the sewage so thoroughly that the probability of any harm resulting from it would be extremely remote.

Either of these outlets is preferable, in its distance from the city, to the nearer outlets previously considered. The advantage of the nearer outlets is in their less cost; and, in considering their relative advantages in relation to the financial resources of the city, it should be considered that forty years hence the population of the city may be such that it may then be advisable on sanitary grounds to move the nearer outlets to one of the more distant localities. The question of choice is resolved into a financial one, involving the resources and probable growth of the city. The system of disposal now proposed is intended to serve for a large city. It now includes West Quincy, which was not included in the former system; and, before it is adopted, a study should be made of the method by which other outlying districts of the future city can be served; and, before the main system of sewerage within the city and the position of the main pumping system is finally determined, the Board would advise that a more thorough study should be made of the best way to dispose of the sewage of Atlantic, North Wollaston, and the land between Wollaston and Quincy Bay.

Pittsfield. The committee on sewerage of the Pittsfield fire district, on Jan. 27, 1890, presented to the Board a revised plan of sewerage and sewage disposal, and requested the advice of the Board upon the same.

To this application the Board replied as follows: —

Boston, April 1, 1890.

In revising this plan the suggestions contained in the reply of this Board to you, dated Dec. 13, 1889, have been followed, in part, by the abandoning of the high-level main sewers, the storage tanks and the pumping stations at Van Sickler's and Pomeroy's mills, and by extending the main sewers to a pumping station located not far from the confluence of the east and west branches of the river. These changes overcome the objections made to the former plan from a sanitary point of view.

In regard to the sizes of the main sewers on the two sides of the district, the suggestions of the Board in its reply to you have not been followed, the revised plan showing sewers that have many times the capacity of those suggested by the Board. As this difference in size is one which affects to a very large extent the cost of the system of sewers, the consulting and chief engineer of the Board was requested to reconsider this feature; and they are of opinion that sewers of the sizes suggested by the Board will be able to convey all of the house sewage, such portion of the manufacturing waste as cannot be safely turned into the river, and so much of the ground water as cannot be kept out of the sewers by proper design and construction. In reaching this opinion, they have given due consideration to the probable future population of the town, and have kept in mind the fact that the plan provides for the pumping and purification of the sewage. In view of these opinions, the Board is unable to advise the adoption of the revised plan submitted Jan. 27, 1890.

Estimates of the cost of the sewers shown on the revised plan, and of those shown on the former plan, have been presented by your engineer. The relative costs of the sewers shown on these two plans are very different from what they would be if the main sewers had been designed in accordance with the suggestions of the Board. To obtain the relative cost of the two schemes of sewerage, it is also necessary to include the cost of pumping stations, storage tanks, force mains, probable ledge work and land damages, the cost of preparing filtration areas, and the yearly cost of maintaining the works, all of which differ materially in the two plans. In view of these omissions, and the unsatisfactory bases for estimating the cost of the main sewers, the estimates submitted do not add to the information in possession of the Board regarding the relative costs of the two methods of disposing of the sewage; and it therefore has no reason to modify its opinion regarding relative costs, as expressed in its reply to you dated Dec. 13, 1889.

At a conference between the engineers of the Board and your engineer, reference was made to the first plan presented by you, upon which this Board reported on Dec. 13, 1889; and your engineer stated that the high-level sewer, as therein designed, would provide for between two-thirds and three-fourths of the house sewage, including the jail, that now finds its way into the river within the limits of the fire district, and that it was not the intention to recommend the building of low-level sewers at the present time; but, if any portion of the laterals of the low-level system are put in, they would debouch into the river at some point most convenient to themselves, or connect with sewers now existing; and it is not expected to furnish pumps or force mains at the present time, nor until the growth of the district served by the low-level sewers should produce a volume of sewage as great as is now discharged into the river. Should this recommendation be adopted, the Board would advise that domestic sewage and objectionable manufacturing wastes should not be turned into the river above the lowest of the mill dams in Pittsfield.

A modified plan was presented to the Board May 6, 1890, to which the following reply was made: —

Boston, May 12, 1890.

The objections made by the Board, in reply to the committee on sewerage of the Pittsfield fire district, dated April 1, 1890, to the plan then under consideration, related to the sizes of the main sewers. These objections have been removed in the plan now before us, and the Board advises that the main features of the plan of sewers, as now presented, form a satisfactory part of a system of sewage disposal for the town of Pittsfield.

Gloucester. The mayor of Gloucester presented to the Board a plan of sewage disposal, involving the discharge of the sewage of the city into the sea by several outlets, and requested the advice of the Board thereon. To this application the Board replied as follows: —

Boston, March 25, 1890.

The State Board of Health has considered the plan for the sewerage of Gloucester, presented by you on Jan. 28, 1890, and has had the locality examined by its chief engineer.

The problem presented is a difficult one to solve, and the plan presented, though not without objectionable features, overcomes the main difficulties in such a way that the Board is unable to advise a better general way to dispose of the sewage of the parts of the city included in the plan.

The main outlet is to be carried to a little beyond low-water mark. This will require works of a very substantial character; but the discharge of sewage at any point short of this should be strong ground for objection by the property holders in that locality.

The outlet sewer from District No. 2 should be carried as far beyond low-water mark as practicable. The outlet from District No. 3 is not in a satisfactory place. Your engineer stated that this outlet might be extended along the northerly shore of Wonson's Cove to a point of land beyond the mouth of the cove. This modified location would be permissible, but it would be more satisfactory to carry the outlet to low-water mark, if it can be done.

WESTBOROUGH. The committee on sewerage of the town of Westborough presented to the Board, on Feb. 3, 1890, a plan of sewage disposal providing for filtration of the sewage in land near the Assabet River, and requested the advice of the Board thereon. The Board replied as follows: —

APRIL 12, 1890.

The State Board of Health has considered the plan presented by you for the disposal of the sewage of the main village of Westborough by filtration upon land near the Assabet River, and has caused examinations to be made, by its engineer, of this and alternative methods for the disposal of the sewage of the town. From his report, the Board concludes that the plan presented, which is substantially the same as that proposed by the Massachusetts Drainage Commission, is the best one for adoption.

REVERE. In the report of the State Board of Health to the Legislature for the year 1889 (Senate Document No. 4, 1890, page 54), it was stated that the town of Revere, through its sewerage committee, had submitted to the Board a plan of sewerage and sewage disposal. The application was received near the close of the legislative session of 1889, and the subsequent adverse action of the town rendered the proposed action of the State Board unnecessary.

On Feb. 14, 1890, another application was presented to the Board for its advice, signed by a committee consisting of eighteen citizens of Revere. This application was accompanied with the plan, which had been presented in May of the previous year. To this application the Board replied as follows: —

BOSTON, Feb. 18, 1890.

Your application for advice under chapter 375 of the Acts of 1888 was received on Feb. 17, 1890. It states that you have petitioned the Legislature for an act enabling the town to construct and maintain a system of sewerage and sewage disposal, and to raise money therefor; and that, although you have not decided upon any system of sewerage, your application is accompanied by a report of the sewerage committee of the town, made in May, 1889, with a plan of one method of disposing of the sewage. This report was received by the Board at the time of its publication, and received some consideration; but subsequent action of the town rendered further examination then unnecessary. In the short time in which you desire a response to present to the present Legislature, it will be impracticable for this Board to make the necessary investigations to advise as to the best practicable method of disposing of the sewage of Revere.

The Board, in making report to the Legislature upon the sewerage of the Mystic and Charles River Valleys, considered the subject sufficiently to see that an outlet sewer for the sewage of Revere could be built to the general Metropolitan sewerage system by an additional expenditure of $86,000 (Senate Document No. 2, January, 1889, page 32); but, as the town was not in the Mystic Valley, its case was not sufficiently investigated to warrant an opinion as to whether it would be for its interests to join the general system, or not. This will depend upon the future growth of Revere, and upon whether currents can be found that will carry the sewage out to sea without injury to the beaches. It is probable that a location for the outlet can be found that will allow of the discharge of the present small quantity of sewage at certain times of the tide, with no injury to the beaches.

Should the quantity of sewage increase by the growth of the town to such an extent that its discharge becomes objectionable, it may become advisable to then pump it over into the Metropolitan outlet sewer. In designing the works, the Board would advise you to have this alternative in view, in order that as little change as practicable may be necessary to make this disposal, if it should ever become necessary.

There can be no question that Revere, with its public water supply, should shortly be provided with a system of sewerage; and, with the proper precautions in selecting an outlet and with the above alternative made obligatory, if it ever becomes necessary, the Board sees no reason why the interests of all parties may not be advanced by legislative authority.

LEXINGTON. The committee on sewerage of the town of Lexington submitted to the Board an application for its advice (April 18, 1890), upon a plan of sewerage and sewage disposal for the town, the essential features of which involved the discharge of sewage "into two brooks; one flowing around the west side of the Arlington reservoir, thence passing through the east side of Arlington, to receive the sewage of East Lexington, until such time when, by way of the Arlington sewers, it shall pass into the Metropolitan system of sewerage; the rest of the sewage coming from the main part of Lexington, to be discharged into Vine Brook, below or near Hayes' farm." To this application the Board replied as follows: —

Boston, May 6, 1890.

In response to your application of April 18, 1890, for advice as to the most feasible and economical mode of disposing of the sewage of the town of Lexington, the State Board of Health has had such general examinations made as to enable advice to be given upon preliminary points and to point out a way for further examination by the town.

The Board would not advise the discharge of the crude sewage of Lexington Centre into Vine Brook, nor that of East Lexington into Sickle Brook.

The best method of disposing of the sewage of Lexington Centre is to construct sewers, from which storm water is excluded, to convey the sewage down the valley of Vine Brook to such a distance that the sewage can be discharged by gravity upon a sufficient area of porous land, and there be filtered before entering the brook. Probably five acres would answer at present, but ten acres would be desired for future use. The trotting park area could be made to serve the purpose by deep drainage; but the town had better have other areas examined, to see if one cannot be found capable of being prepared at less expense.

For East Lexington it is probable that the best method in the future will be to connect with the Metropolitan system. If this will delay the construction of a sewerage system too long, the town should endeavor to find some suitable land in the valley of Sickle Brook upon which to filter the sewage; failing in this, a temporary method of clarification by chemical precipitation should be considered.

Whitman. The selectmen of Whitman submitted to the Board an application for its advice (April 26, 1890), relative to a plan of sewerage and sewage disposal for the central portion of the town, in which it was proposed "to adopt a combined system of sewers . . . to be turned directly into the stream below the factory of Dunbar, Hobart & Co.; and, should this in time create a nuisance, it is proposed to utilize a tract of land north of the Old Colony Railroad." To this application the Board made the following reply: —

Boston, May 7, 1890.

Neither the whole of the sewage of Whitman, nor such a part of it as could be turned into the sewers shown on the plan submitted, could be discharged directly into the stream below the factory of Dunbar, Hobart & Co., without making the stream offensive at times of low flow; and it is not, therefore, advisable to adopt this method of disposal. The filtration area shown upon the plan submitted is not composed of sufficiently pervious material, or high enough above the water in the brook to dispose of the sewage in a satisfactory manner.

The Board would advise the town to make further examinations, for the purpose of selecting a more suitable area for the filtration of the sewage of the town; and to have a system of sewers designed in which the sewage is kept separate from the storm water. The sewage should be conveyed in small pipes to the filtration area and the storm water in larger drains to the brook. It will generally be advisable to place the storm-water drains lower than the sewage pipes, so that the ground water will be intercepted by the former, and thus keep the volume of sewage to be purified as small as possible.

QUINCY. The committee on sewers and drains of the city of Quincy (May 9, 1890) requested a conference with the Board, relative to the sewage disposal of the city. A hearing was held June 3, 1890, at which it appeared that the Nut Island location, as a place for the sewage discharge of the city, was satisfactory to the city authorities. No further reply by the Board was deemed necessary.

ORANGE. A committee of the town of Erving, and also the inhabitants of other towns situated upon Miller's River below the town of Orange, requested that the Board would give a "full investigation" to the question of the proposed discharge of the sewage of the town of Orange into Miller's River. A hearing was held at the office of the Board, July 1, 1890, at which the towns of Orange, Erving and Wendell, as well as certain manufacturing corporations upon Miller's River, were fully represented. On August 5, the Board sent the following reply to the authorities of the towns in whose interest the hearing was held: —

BOSTON, Aug. 5, 1890.

The State Board of Health has given a hearing to the inhabitants of Erving and others, living upon the borders of Miller's River below Orange, in regard to the proposed discharge of the crude sewage of Orange into the river. The Board has also had examinations made of the river, to determine the quantity of water that is likely to flow therein in dry weather, and the probable effect upon the health of the communities if it is allowed to receive sewage.

The amount of sewage that can, with the present population of Orange, be turned into the river, would under ordinary circumstances be so small in amount compared with the quantity of water flowing in the river in summer that it could have no effect on the health of people living on the borders of the river. The exceptional condition that would in this case render harm probable is the custom, maintained at some of the mills below Orange, of drawing the water at night below the top of their dams, and thus exposing flat areas that are covered with water during the day. This practice will render a less degree of pollution objectionable on this stream than would otherwise be allowable. But, as the pollution of this stream after the sewage of Orange enters it will not, for a number of years, be as great for each gallon of water that flows in the summer as the pollution of some streams used for drinking, the State Board of Health has not thought it necessary to advise the town of Orange to purify its sewage at present, in order to protect the health of the people living near the river; but it has advised the town to so construct its system of sewerage that it can, with the least cost, introduce a method of purification whenever the degree of pollution from all causes may threaten the public health.

WINTHROP. The Board of Health of Winthrop applied to the Board (May 23, 1890) for its advice relative to the removal of certain deposits of offensive matter upon the flats in the cove between the main portion of the town and Point Shirley. To this application the Board replied as follows: —

BOSTON, July 1, 1890.

The State Board of Health has, in response to your application of May 23, had examinations made of certain deposits of offensive matter in the cove between the old portion of the town and Point Shirley. These deposits are found to be in the vicinity of and inside of the trestle built two years ago by the Boston, Winthrop & Shore Railroad, the worst portion being near the westerly end of the trestle. The deposits are about eight inches deep, and extend over about two acres. They are masses of soft, very dark-green, offensive matter, covered in places with a light-colored deposit of sulphur. About one-eighth of the mass appears to be organic matter, a part of which is growing and a part decaying. The latter, reducing the sulphates from the sea water, produces the offensive odor of sulphuretted hydrogen.

The Board has not yet been able to trace the source of this organic matter, and is unable to recommend any means of overcoming its offensiveness while it remains. The Board therefore advises you to treat it as any other mass of accumulated filth, — that is, to gather it up, and take it out to sea.

WINTHROP. The selectmen of Winthrop applied to the State Board of Health for its advice and recommendation with reference to a proposed addition to its sewerage system, consisting of a branch sewer connecting with the main sewer near Cross Street in Winthrop. To this application the Board replied as follows: —

BOSTON, June 9, 1890.

In reply to your application of June 2, 1890, relative to a proposed sewer in the town of Winthrop, intended to be located between Summit Avenue and Locust Street, and to connect with the present sewerage system at a point in Locust Street near Cross Street (as shown in accompanying plan), I am authorized to state that the aforesaid addition to the present system is approved by this Board.

FRAMINGHAM. In the course of construction of the system of sewerage for the town of Framingham, an underdrain had been built, the effect of which was to "lower the water-table of the area reached by said underdrain, and to decrease the amount of water in the sewage to be pumped." The city of Boston demanded that the underdrain should be closed, and the discharge from it stopped; alleging that it was a menace to the city, since the discharge from the underdrain was within the watershed of Lake Cochituate, one of the water supplies of Boston. The selectmen of Framingham therefore applied to the State Board of Health (May 26, 1890) for their advice upon the question "whether, considering all the circumstances, and the quality of the water running from said underdrain, the discharge from said underdrain should be stopped by the town." The Board replied to the authorities of Framingham as follows: —

BOSTON, Sept. 2, 1890.

The State Board of Health has had in careful consideration your application for advice of May 6, 1890, concerning the discontinuance of an underdrain which was built beneath the main sewer, which underdrain discharges into Lake Cochituate, a source of Boston's water supply. Upon examination of the approval by this Board, dated May 13, 1888, to which you refer, you will see it was limited to the proposed system of sewage disposal and the location of the field, and did not include this underdrain for the lowering of the ground water of the village. There is, however, no question in the minds of the Board that the lowering of the ground water through the village is a result very desirable to be attained.

That the character of the ground water might be known before any sewage was turned into the sewer, this Board had a sample of the water coming from the drain, on Oct. 22, 1889, analyzed; and in every month since January, 1890, one or more similar samples have been analyzed, with the general result that the water coming from the drain is no worse since sewage was put into the sewer than previously, showing that sewage does not, up to the present time, leak directly from the sewer into the drain. The water coming out of the drain contains about half as much chlorine as ordinary sewage, and five per cent. as much free ammonia and one per cent. as much albuminoid ammonia. Its nitrates and nitrites are high. These all indicate that the source of this water is sewage-polluted ground, and probably drainage from cesspools. As the sewage of the town is more generally turned into the sewers, and cesspools are cleaned out and abandoned, it is probable that the water of the underdrain will improve in quality from year to year, if there occurs no leakage from the sewer to the underdrain.

To determine the changes that take place in the water of the drain before it reaches the conduit of the Boston water works, samples of water were, on Aug. 8, 1890, collected from six points, as follows: —

No. 1. From underdrain outlet.

No. 2. From Beaver Dam Brook, above the outlet of the drain.

No. 3. From the brook three hundred feet below the outlet. Here the quality of the water was what would be expected from a mixture of No. 1 and No. 2 in their respective quantities.

No. 4. From Mill Street crossing, a mile below the outlet. Here the nitrates and chlorine showed no change from No. 3, except a ten per cent. dilution; but the free amonia had been reduced by plant growth from 0.0236 parts per 100,000 to 0.0016 parts, and albuminoid ammonia had increased from 0.0102 parts to 0.0152 parts.

No. 5. From one-third of a mile below Mill Street, at the crossing of the Albany Railroad. This distance is through a broad, sluggish section of the stream, in which are many water plants. Here the chlorine is three-quarters that of No. 4, but the nitrates have been taken up by the vegetable growth, and reduced from 0.2000 parts to 0.0200 parts. The free ammonia has been slightly increased from 0.0016 parts to 0.0024 parts, but the albuminoid ammonia has increased from 0.0152 parts to 0.0752 parts.

The *sixth* sample, taken four hundred feet below, did not differ materially from the fifth.

In flowing from the outlet of the drain to the lake, there is an entire change in the chemical constituents of the impurities of the water; the nitrates and free ammonia are appropriated by the organisms, which in turn produce albuminoid ammonia, so that we can well say that little if any of the organic matter discharged by the drain reaches the lake; but the organic and mineral matter from the drain serves as food for a new class of organisms, some of which are objectionable. The only organism found by the microscope in the water discharged by the drain is Crenothrix. This all disappears, perhaps in part by settling to the bottom, before reaching the lake; but at Station 5 we find, in 100 cubic centimeters of the water, 46,000 Anabaena, 179,000 Synedra; 266,000 Zoospores, many other organisms in smaller numbers, and an abundance of microscopic animal life. It is probable that these organisms are increased in quantity, near the outlet of this brook, by receiving food from the underdrain; and, as some of these organisms are of the kinds that cause unpleasant taste and odor in Boston's water, their growth is objectionable.

The more intimate and direct connection made by the underdrain between cesspools and sewage-soaked ground in Framingham and Lake Cochituate would probably increase the risk of disease-producing bacteria being conveyed to Boston's water. Enough is not known upon this subject to enable a sure conclusion to be made; but, if disease germs would survive the passage by this more direct route, when they would not survive the much longer course of soaking through the ground to the nearest brook, the results may be of so much consequence that it would not be safe to conclude, in the present state of knowledge, that such communication as the underdrain gives is not a menace to the healthfulness of Boston's water, which that city should guard against. The number of bacteria at present found in the water from the drain is smaller than the number found in the brook above its entrance, and the kinds found at the outlet appear to survive through the passage to the lake. The drain increases the risk to the city of Boston in another contingency; viz., that of a leak occurring in the sewer, or in some of the connections that may be made with it, by which sewage may be conveyed quite directly to the underdrain. The chemical analyses indicate that this has not yet occurred, but its occurrence in the future is not improbable. A continued series of analyses and prompt repair of leakage when discovered might guard against injurious results; but the risk to the city of Boston is undoubtedly increased by the drain.

Reviewing all of the conditions, the State Board of Health concludes that the underdrain is of advantage to the sanitary condition of Framingham; that it increases to some extent the risks of pollution to the water supply of the city of Boston; that, if the water flowing in the underdrain were conveyed out of the drainage area, the water supply of Boston would be better than if the underdrain did not exist; and advises that the town of Framingham and the city of Boston make an equitable arrangement, by which this water may be pumped to the filtering area of the town of Framingham. The Board would also advise that, in arranging for pumping, connection should be made with the part of the drain which is at the lowest level, to guard against its filling up with sand, which the Board is informed is now accumulating therein.

ATHOL. In the report of the Board for 1887 (Senate Document 4, January, 1888), it appears that the sewerage committee of Athol applied to the Board for its advice relative to a proposed plan of sewerage, involving discharge of the sewage into Miller's River, to which the Board replied that the town was prohibited from such disposal by the Public Statutes (chapter 80, section 96). At the same time the town was advised to have examinations made, with reference to disposal of the sewage by filtration.

In August, 1890, the selectmen of Athol applied to the Board for advice upon the same question, the claim being urged that the prohibition imposed by the statutes did not apply to Athol. To this application the Board replied as follows: —

BOSTON, Dec. 2, 1890.

The question which the State Board has been asked to consider especially is the right of the town to discharge its sewage into Miller's River, as proposed. The Board can see no new reasons advanced or change of conditions from those considered in the year 1887, when the town of Athol then submitted plans for a sewerage system. At that time the Board replied that "so long as the river is used as a supply for drinking-water at Orange, Athol is, by chapter 80, section 96, prohibited from discharging sewage into the river."

The question having been raised whether the statute applies to the water supply of the town of Orange, claim being made that Miller's River is not so used, the State Board is of opinion that, under the existing state of affairs, — the river being used as a source of supply for a part of the town whenever absolutely required, although infrequently, and only as a last resort, — the statute restrains the town of Athol from the use of this river for the discharge of its sewage.

EXAMINATION OF WATER SUPPLIES, AND PURIFICATION OF SEWAGE AND OF WATER BY FILTRATION.

The complete report of the Board upon its investigations of the water supplies of the State in 1887, 1888 and 1889, and upon the work at the experiment station of the Board at Lawrence for the same period are just being issued from the press under the authority of chap. 80 of the Resolves of 1889. A summary of the work in these departments for the past year is now presented.

Examination of Water Supplies.

In pursuance of the policy of the Board to gain a thorough and intimate knowledge of the natural waters of the State, the regular monthly chemical and biological examinations of the water supplies have been continued during the past year. Some of the supplies which had been continuously examined for two or three years, and concerning which it was thought that sufficient information had been obtained, have been dropped from the list of the waters examined; but the examination of the supplies of all the larger cities has been continued, as well as many others which it was thought desirable to study for a longer period.

The chemical and biological data collected during the past year realize the expectation of the Board with regard to the great value of long-continued examinations of the natural waters of the State, and serve to emphasize the statements which the Board has made in previous reports, that not only are examinations of waters covering only a short period insufficient to reveal the real character of the water, but that they may be actually misleading.

The bearing of these examinations on the quality of waters is two-fold: first, the evidence which they afford of pollution when the waters have been contaminated by household wastes; and second, on the occurrence in surface waters of unpleasant tastes and odors.

With regard to pollution, we have the most conclusive evidence in the amount of chlorine in the water. Mention was made in a previous report of the determinations of "normal chlorine" in the unpolluted waters of the State. Much attention has been devoted to this subject, and the map of normal chlorine (published in the complete report on Water Supply and Sewerage), which has been prepared with great care, shows by the *isochlors*, or lines of like chlorine contents, the amount of chlorine which may be expected in the natural unpolluted waters in all parts of the State, except very near the sea. When the amount of chlorine found in a water is more than this normal, it is (with some limitations which are fully explained in the complete report) to be taken as an evidence that the water has at some time been polluted by sewage or household wastes.

It is believed that this is the first time that this valuable conception of "normal chlorine" has ever been made of practical use in sanitary water analysis. The labor involved in this work has been very great, but the results fully justify the time devoted to it. It is still desirable to do much more work in this line, to cover more completely all portions of the State; but it is safe to say that there is no territory in the country as large as Massachusetts in which data of this kind are as numerous and comprehensive.

The normal chlorine lies now at the basis of our classification of waters, as regards pollution, and is a most important aid in forming an intelligent judgment as to the quality of a water from a chemical analysis.

In the matter of pollution by sewage, we have also added much to our knowledge in respect to the distinction to be made between recent and remote contamination, and of the nature of the processes of purification which polluted waters undergo when exposed to light and air in streams or ponds and when percolating through porous soil. Pollution by sewage is, chemically speaking, the addition of nitrogen compounds to the water, in the forms of organic nitrogen and ammonia. When the water is purified in porous ground, the final result is the conversion of all the nitrogen into its most highly oxidized condition, that is to say, into nitrates; and the amount of the nitrogen in this form is an indication of the amount that once existed in the organic form. This process is one which is being thoroughly studied in connection with the sewage filtration experiments of the Board at Lawrence. In the purification of surface waters two conditions obtain; namely, an oxidation of the organic nitrogen and ammonia to nitrates, and the appropriation of the nitrates and also of the ammonia by living plants in the water. The purification of polluted waters by the conversion of oxidized products of nitrogen and of ammonia into organic nitrogen by water plants has already been alluded to in a previous report of the Board. Additional experience has served to confirm our views as to the importance of this natural process of purifying waters.

A good illustration of the character and rapidity of this process under favorable conditions is found in the following series of analyses of Beaver Dam Brook, into which flows the water of the underdrain of the South Framingham sewerage system. At the time the analyses were made, the water of the underdrain was diluted by rather more than its own volume flowing in the brook.

Analyses of Water from Framingham Underdrain and from Beaver Dam Brook above and below, made Aug. 8, 1890.

[Parts per 100,000.]

Sample Collected from	Chlorine.	Ammonia.			Nitrogen as	
		Free.	Albuminoid.		Nitrates.	Nitrites.
			Dissolved.	Suspended.		
Beaver Dam Brook, above entrance of stream from underdrain, ...	0.77	.0018	.0146	.0022	.0125	.0001
Underdrain at outlet, ...	3.62	.0648	.0058	.0000	.6000	.0036
Brook, 300 feet below entrance of stream from underdrain, ...	2.20	.0236	.0100	.0002	.2200	.0023
Mouth of brook proper, 1 mile below underdrain, ...	2.02	.0016	.0134	.0018	.2000	.0005
Estuary of brook, 1,700 feet below its mouth,	1.54	.0024	.0302	.0450	.0200	.0019
Estuary of brook, 2,100 feet below its mouth,	1.39	.0044	.0286	.0240	.0200	.0012

Note. — The estuary of Beaver Dam Brook is also an arm of Lake Cochituate.

Here we have a striking instance of the prompt conversion of badly polluted ground water, containing much dissolved nitrogen as ammonia, nitrites and nitrates, into one in which the nitrogen is mainly in the form of insoluble green vegetable matter, which is, presumably, in its living condition innocuous to health. The sanitary significance of the nitrogen compounds in surface and ground waters, and the bearing which chemical and biological analyses have on the micro-organisms in the water, will be found fully discussed in the complete report.

Another interesting and important investigation which has been carried on for the last two years is the determination of the composition of the water at different depths in deep ponds and reservoirs.

It has been found that, in ponds having a depth of more than twenty feet, the bottom water remains stagnant for about seven months during the warmer part of the year, while the upper layers are kept in circulation by the wind and by surface streams which feed the ponds. In some ponds this bottom water to which the air does not have access becomes very foul, containing much free ammonia with an absence of dissolved oxygen, and smelling of carburetted and sulphuretted hydrogen. The cause of this stagnation is the greater warmth of the upper layers during the summer; and when on the approach of winter the surface is cooled, the lower foul layers come gradually into circulation and cause a marked deterioration in the quality of the water nearer the surface.

It is not every deep pond in which the bottom layers thus become foul, but mainly those in which the bottoms contain much decomposing organic matter, or in which the vegetable and animal forms of life in the pond are abundant, and decompose in the lower layers or on the bottom to which they sink when they die.

This phenomenon has been carefully studied at Jamaica Pond, where the bottom water becomes very foul in summer, and the results will be found in detail in the complete report. As an indication, however, of the great changes which take place in a pond of this character, the following condensed table is presented: —

DATE.	AMMONIA.				NITROGEN AS			
	FREE.		ALBUMINOID.		NITRATES.		NITRITES.	
	Surface.	Bottom.	Surface.	Bottom.	Surface.	Bottom.	Surface.	Bottom.
Nov. 27, 1889, ...	.0640	.0712	.0246	.0236	.0120	.0150	.0009	.0009
April 4, 1890, ...	.0006	.0008	.0376	.0340	.0350	.0480	.0010	.0012
Aug. 14, 1890, ...	.0000	.4720	.0362	.0460	.0030	.0150	.0000	.0000

It will be observed that the water is nearly of uniform quality at the surface and bottom on the first two dates, both of which represent periods when the water circulates to the bottom. The first, however, contains most of the nitrogen in the form of free ammonia, while in the second this is nearly absent, and the nitrogen appears mainly in the organic form as albuminoid ammonia, and as nitrates. The last date represents the period of stagnation when much of the nitrogen is in the lower layers in the form of free ammonia.

The necessity of having a supply of water in reservoirs and tanks for fire purposes and other emergencies, and the need of still more extended storage in many cases to prevent a deficiency in the supply during the dryer portions of the year, together with the fact that to such storage can be traced most of the bad tastes and odors which affect water supplies, make the subject of storage one of especial concern, and it will be found treated at length in the complete report. A summary of the results, however, will be given here.

The storage of surface waters in open distributing reservoirs does not generally effect any important change in the water, but such as does occur is beneficial rather than otherwise.

The recent work emphasizes the view already given in previous reports, that ground waters should be stored in reservoirs from which light is excluded, as they are very liable, otherwise, to cause unpleasant tastes and odors in the water. During the past year the Hyde Park Water Company and the city of Newton, which have heretofore used open reservoirs, have built covered ones.

In the case of surface waters bad tastes and odors most frequently occur where water is stored in ponds or artificial reservoirs which hold more than a month's supply, and not in the smaller reservoirs, such as are quite commonly built upon mountain streams. There are 71 examples of the former class which have been investigated. Of these, 45, or 63 per cent., have at some time given trouble from bad tastes and odors. In 3 of these the trouble is due to the recent filling of reservoirs which have not been cleaned, and may or may not continue. In 16 other cases the trouble has not been serious, or has occurred only at long intervals, so that after making these deductions there are 26, or 37 per cent., of the ponds and older reservoirs which have given much trouble. These troubles are caused for the most part by the growth and decay of organisms which thrive, because they are supplied with nitrogenous food derived either from sewage or from vegetable matter contained in the bottom of uncleaned reservoirs. For instance, if the ponds are classified by calling all those polluted which receive either directly, or indirectly by filtration, the sewage of a population of 300 per square mile, and those unpolluted which receive less, it will be found that all of the polluted have given some, and half of them much, trouble from bad tastes and odors, while of 25 similar ponds which are unpolluted only one has given much trouble, 6 have given a little, and 18 none. It is also noticeable that the amount of trouble corresponds quite closely with the amount of population on the drainage area.

Artificial reservoirs as a rule have given more trouble than ponds, although only two of them are polluted according to the arbitrary definition above given. Those that are polluted have given trouble the same as the ponds. Of those that are unpolluted, all which have been cleaned by having the soil and vegetable matter removed from them have not given trouble, and the same is generally true where old mill ponds or reservoirs have been used for storing water for domestic use. The most trouble has occurred in shallow uncleaned reservoirs.

Recent experience in the storage of water in new cleaned and uncleaned reservoirs is instructive. Reservoir IV. of the Boston Water Works was filled about a year before the Board began its investigations. The Stony Brook Reservoir of the Cambridge Water Works, the Quincy Reservoir, and the reservoirs at Lynn, known as Glen Lewis and Walden ponds, have been filled since. Of these five reservoirs, the first two only were cleaned. The effect of the character of the reservoir upon the stored water is best indicated in a chemical analysis by the free ammonia — which is a product of decomposition — and the albuminoid ammonia, particularly the suspended portion of the latter, which indicates the abundance of organisms and other suspended organic matter contained in the water. The following table shows the amount of these constituents in the five reservoirs: —

Table showing Amount of Free and Albuminoid Ammonia in New Cleaned and Uncleaned Reservoirs.

RESERVOIR.	Condition.	Date of Filling.	Date of Collecting Samples.	Number of Months between Dates.	AMMONIA.			
						ALBUMINOID.		
					Free.	Total.	Dissolved.	Suspended.
Reservoir IV., . .	Cleaned, .	Apr., '86,	Aug., '87,	16	.0005	.0229	-	-
Reservoir IV., . .	Cleaned, .	Apr., '86,	Aug., '88,	28	.0002	.0286	.0254	.0032
Stony Brook Reservoir,	Cleaned, .	Aug., '87,	Aug., '88,	12	.0010	.0288	.0234	.0054
Quincy Reservoir, . .	Uncleaned,	Dec., '88,	Aug., '89,	8	.0200	.0466	.0386	.0080
Quincy Reservoir, . .	Uncleaned,	Dec., '88,	Aug., '90,	20	.0110	.0360	.0272	.0088
Glen Lewis Pond, . .	Uncleaned,	Dec., '89,	Aug., '90,	8	.0632	.0902	.0746	.0156
Walden Pond, . .	Uncleaned,	Dec., '89,	Aug., '90,	8	.0576	.0746	.0560	.0186

It has frequently been stated that water having a high color would lose most of it by exposure to the sun and air in open reservoirs. A comparison of long-continued observations of water entering and flowing from several reservoirs shows that this bleaching action does take place, though very slowly, so that water must be stored several months to cause any material reduction in color, and from six months to a year in order to remove practically all of it.

During the past year chemical and biological examinations have been made of one hundred and thirty wells in different parts of the State, which are used more or less by the public. Some of these have been found to be very much polluted by household wastes, and others contain water that has been previously polluted but has been purified by intermittent filtration through the ground, and a few indicate no pollution. The worst of these wells are being studied with care, to determine the sanitary significance of their present pollution, and the effect it has had upon those who have used the waters. Publication of the results of examinations will be delayed until these studies have reached more definite conclusions.

During the past two winters so little ice has formed on the streams and ponds that we have yet been unable to study the effect of a long-continued covering of ice, excluding air from the water. It now appears that such a study may be made this winter.

The general continuance of high water, due to unusual amounts of rainfall, since the study of the water supplies was commenced has prevented the study of streams and ponds in time of drought.

WORK AT THE LAWRENCE EXPERIMENT STATION.

The experiments upon the purification of sewage and of water, by intermittent filtration, have been continued another year, partly with new materials, but principally with increasing quantities of sewage or of water, upon materials that had been in use as filters during the previous two years.

Among the most interesting results obtained, upon the intermittent filtration of sewage, were those in which the filtering material was entirely of gravelstones as large as beans. The sand had not only been screened out, but all of the stones had been washed, so that no sand adhered to them, before they were put into the tank. They formed a bed five feet in depth; and for nine months sewage pumped directly from the city sewer was applied nine times a day, for six days in the week, in quantity equivalent to 81,400 gallons per acre per day. The quality of the effluent varied somewhat; but during the last two months, June and July, after the above quantity had been applied daily for more than seven months we obtained the following average results: —

DATE.		Quantity in Gallons.	AMMONIA.			Chlorine.	NITROGEN AS		Bacteria per Cubic Centimeter.
			Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.	
1889.									
May 23-June 22,	Sewage, .	–	1.9919	0.6031	2.5950	5.16	0.0000	0.0000	–
	Effluent, .	3.5	0.0031	0.0375	0.0406	6.00	2.0700	0.0002	10,305
	Per cent.,	–	0.2 of 1	6.	1.5	–	–	–	–
June 23-July 22,	Sewage, .	–	2.2500	0.7255	2.9755	7.46	0.0000	0.0000	1,813,500
	Effluent, .	3.5	0.0050	0.0354	0.0404	9.01	2.2500	0.0004	13,523
	Per cent.,	–	0.2 of 1	5.	1.3	–	–	–	0.7 of 1

Here we find that 98.6 per cent. of the organic matter of the sewage, shown by the sum of ammonias, is removed by being burned and converted into nitrates, and more than 99 per cent. of the bacteria that were in the sewage were killed. We must regard this as a remarkably good result, with an effluent averaging 70,000 gallons an acre for every day in the year.

The foregoing results were so satisfactory that the quantity was increased by applying the same amount hourly for fourteen hours, instead of for nine hours. The quantity applied was then the equivalent of 126,600 gallons per acre per day, for six days in the week. This quantity was continued for three months, until Oct. 24, 1890, with very little change from the result previously obtained.

The average results for the last month were as follows: —

DATE.		Quantity in Gallons.	AMMONIA.			Chlorine.	NITROGEN AS		Bacteria per Cubic Centimeter.
			Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.	
Sept. 24-Oct. 24,	Sewage, .	–	2.0559	0.6453	2.7012	5.55	0.0000	0.0000	3,034,000
	Effluent, .	5.0	0.0068	0.0325	0.0393	6.42	1.5700	0.0003	11,592
	Per cent.,	–	0.3 of 1	5.	1.5	–	–	–	0.4 of 1

We still find 98.5 per cent. of the organic matter of the sewage is removed, and its nitrogen is in the mineral form of nitrates; and more than 99.6 per cent. of the bacteria are killed. This result was so satisfactory that the quantity was still further increased in November.

These results show more definitely than any others the essential character of intermittent filtration. We see that it is not a straining process. By the application of small quantities of sewage over the whole surface of the tank each hour, each stone in the tank was kept covered with a thin film of liquid, very slowly moving from stone to stone, from the top towards the bottom, and continually in contact with air in the spaces between the stones. The liquid, starting at the top as sewage, reached the bottom within twenty-four hours, with the organic matter nearly all burned out. The removal of this organic matter is in no sense a mechanical one of holding back material between the stones, for they are as clean as they were a year ago; but it is a chemical change, aided by bacteria, by which the organic substances are burned, forming products of mineral matter, which pass off daily in the purified liquid.

The liquid flowing out at the bottom is a clear, bright water, comparing favorably, in every respect that can be shown by chemical or biological examination, with water from some of the wells on the streets of our cities that are used for refreshing draughts by the public during the summer.

Filter Tank No. 1.

This is composed of very coarse mortar sand. From Oct. 11 to Dec. 3, 1889, a trap was upon the outlet, excluding air, and the purification was not so satisfactory as previously. In accordance with the conclusions given in the previous report, the surface of this tank was spaded under to a depth of about four inches on November 27; and, for the purpose of washing out the salt that was in the tank from sewage, city water was applied, 500 gallons three days in the week, from November 28 to December 7. This was done for the purpose of determining, upon again applying sewage, by the increase of chlorine, how rapidly the foremost particles of sewage flow through this sand, when applied in considerable quantity. While city water was being applied, the average analysis of the effluent was as follows, in parts per 100,000:—

Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrates.	Nitrites.
0.0018	0.0119	1.05	0.7418	0.0011

On the last day the chlorine was reduced to 0.46 parts. Sewage began to flow onto the sand at 10.53 on December 9, and 500 gallons continued to flow on till 11.44. There was no increase in flow at the outlet at 11.29, but at 11.32 the flow out had increased from one-fortieth of a gallon per minute to one-tenth of a gallon, and in the next three minutes the rate of flow increased to nine-tenths of a gallon per minute, and thereafter continued increasing until 12 o'clock, when the rate was fifteen gallons per minute.

At 11.32 the number of bacteria in a cubic centimeter of the effluent was 70, a little higher than it had been through the morning; but at 11.35 the number had increased to 2,190 per cubic centimeter, and three minutes later the number was 1,886. The increase to 2.190 at 11.35 indicates that as much as two-thirds of one per cent. of the effluent was then of the sewage, which contained 300,000 bacteria per cubic centimeter. At this time not more than six gallons of liquid had flowed out after the first sewage was put on the surface, a period of forty-two minutes; but it was not more than six minutes after the application of sewage began to increase the flow at the outlet.

The indication of the arrival of the most advanced particles of sewage at the outlet, by the increase in chlorine, comes a little later than that by the increase in bacteria. One reason may be that the chlorine at the outlet was decreasing while sewage was coming down through the sand, and perhaps it would have decreased faster if some forward particles of sewage had not added some chlorine.

At 11.35 the chlorine of the effluent was 0.60 parts; at 11.36, 0.52 parts; at 11.38, 0.46 parts; and at 11.41 it had stopped decreasing, being still 0.46 parts, and after this it steadily increased. This indicates that the forward particles of sewage reached the outlet when fourteen gallons of effluent had been pressed out by sewage applied at the surface. This was at 11.39, or four minutes later, and after eight more gallons had passed out, than when the increase in the number of bacteria indicated the arrival of sewage.

From this we learn that the 1,000 gallons of liquid held in the smaller interstices of this coarse sand, after it has been draining for a day or more, are to a very small extent pushed down by the forward particles of the incoming sewage; but that some of these particles move rapidly down through the larger interstices, pushing before them but little of the contained water, and reach the outlet within three-quarters of an hour after being applied at the surface, having pushed before them not more than one per cent. of the contained water.

We have the following series of analyses of sewage and of effluent during the day, Dec. 9, 1889:—

	Time of Collection.	RESIDUE ON EVAPORATION.		AMMONIA.			Chlorine.	NITROGEN AS		Rate of Flow. Cubic Centimeters per Minute.	Number of Bacteria per Cubic Centimeter.
		Loss on Ignition.	Fixed.	Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.		
Sewage,	-	-	-	.8000	.4800	1.2800	2.80	-	-	-	304,200
Effluent,	8.34	1.2	9.3	.0022	.0082	.0104	.70	.5700	.0001	80	24
"	10.32	-	-	-	-	-	-	-	-	73	29
"	10.44	2.0	8.1	.0022	.0100	.0122	.75	.6500	.0001	78	-
"	10.53	-	-	-	-	-	.72	-	-	76	15
"	11.11	-	-	-	-	-	.72	-	-	75	10
"	11.14	-	-	-	-	-	.72	-	-	77	19
"	11.23	-	-	-	-	-	.72	-	-	77	12
"	11.29	-	-	-	-	-	.72	-	-	76	Broken.
"	11.32	-	-	-	-	-	.62	-	-	273	70
"	11.35	-	-	-	-	-	.60	-	-	2,680	2,190
"	11.36	2.2	7.0	.0010	.0176	.0186	.52	.4400	.0001	4,000	-
"	11.38	-	-	-	-	-	.46	-	-	7,320	1,886
"	11.41	-	-	-	-	-	.46	-	-	10,680	10,080
"	11.44	2.5	4.7	.0030	.0360	.0390	.56	.2200	.0006	12,000	3,828
"	11.47	-	-	-	-	-	.67	-	-	14,800	9,744
"	11.50	-	-	-	-	-	.79	-	-	17,300	4,850
"	11.53	-	-	-	-	-	.82	-	-	19,100	Liquified.
"	11.56	3.6	6.8	.0146	.0450	.0596	.94	.2600	.0008	22,000	14,580
"	12.02	-	-	-	-	-	.94	-	-	46,200	9,108
"	12.05	5.5	6.9	.0236	.0470	.0706	1.00	.2700	.0010	30,150	8,580
"	12.11	-	-	-	-	-	1.04	-	-	14,800	10,824
"	12.17	5.0	5.5	.0220	.0514	.0734	1.06	.2800	.0010	13,920	7,740
"	4.32	2.4	7.8	.0194	.0338	.0532	1.37	.3700	.0004	920	8,360

Five hundred gallons of sewage applied from 10 h. 53 m. to 11 h. 44 m.

These observations show that when the chlorine began to increase, the free and albuminoid ammonia also increased; and, soon after, the nitrates increased.

To determine whether the ammonias and nitrates pass through in quantities proportioned to the chlorine, or whether they undergo important changes in the quick passage of the more advanced particles, we have computed the different forms of nitrogen, as if they came through without change, in proportion to the amount of chlorine. The assumption is made, in accordance with the condition of the effluent on the previous days, that thirty-three per cent. of liquid like that of the effluent in the morning before sewage was applied, formed one portion of the effluent continually, and this, together with such amounts of city water from the upper part of the tank, and of applied sewage, as will give the existing chlorine at any hour, make up the existing effluent.

The actual analyses of the effluent at different times, in the forty minutes after sewage appeared at the outlet, are given in the following table, followed by the computed analyses: —

TIME.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrates.	Nitrites.	No of Bacteria.	Per cent. of Sewage.
11.44, ...	0.0030	0.0360	0.56	0.2200	.0006	3,828	–
Computed, ...	0.0577	0.0376	0.55	0.2000	.0001	21,000	7
11.56, ...	0.0146	0.0450	0.94	0.2600	.0008	14,580	–
Computed, ...	0.1775	0.1145	0.93	0.2000	.0001	66,000	22
12.05, ...	0.0236	0.0470	1.00	0.2700	.0010	8,580	–
Computed, ...	0.2015	0.1285	1.01	0.2000	.0001	75,000	25
12.17, ...	0.0220	0.0514	1.06	0.2800	.0010	7,740	–
Computed, ...	0.2500	0.1560	1.07	0.2000	.0001	93,000	31

These results, though approximate only, give assurance of a marked chemical change within a few minutes, so that sewage which is ten minutes longer on the passage through the sand comes out with free and albuminoid ammonia and the number of bacteria much more reduced than that having a shorter passage. The nitrates also indicate an increase, with a short increase in the time of passage, which is confirmed by other experiments; but the amount of this increase and the change in the nitrites are the least certain points in the computation.

The short time in which sewage—applied in large quantity after an intermission—passes through five feet of very coarse sand, before nitrification can become complete and before all of the bacteria can be killed, indicates the advantage, with such material, of more frequent applications of small quantities.

The longer time required by a fine sand for the first application of sewage to pass through is shown by an experiment on Tank No. 2, when, under similar circumstances, it required a week for the most forward particles to reach the outlet.

Upon resuming the application of sewage, it was found that, while the nitrates were high, the ammonias were also higher than in the previous year. This condition continued for about two months, or until the middle of February, 1890. The average result was as follows: —

Free ammonia, .	0.1048, or 7 per cent. of that of the sewage.
Albuminoid ammonia,	0 0330, or 5 per cent. of that of the sewage.
Sum of ammonias,	0.1378, or 7 per cent. of that of the sewage.
Chlorine, . .	4.55.
Nitrates, . .	1 0677.
Nitrites, . .	0.0010.

Quantity per acre daily, 52,000 gallons.
Bacteria per cubic centimeter, 2,705.

After this the nitrates increased for three months from 1.3 parts to 3.0 parts per 100,000, and the sum of ammonias decreased until the middle of May, after which, for a month, while filtering at the rate of 50,000 gallons per acre per day, the resulting analyses were as follows: —

Free ammonia, .	0.0028, or 0.1 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0202, or 3 per cent. of that of the sewage.
Sum of ammonias,	0.0230, or 1 per cent. of that of the sewage.
Chlorine, . .	5.09.
Nitrates, . .	2.3583.
Nitrites, . .	0 0002.

Bacteria per cubic centimeter, 3,296.

After the middle of June the quantity filtered was increased to 77,000 gallons per acre per day, with the following average result for three months: —

Free ammonia,	0.0152, or 0.7 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0406, or 5 per cent. of that of the sewage.
Sum of ammonias,	0.0558, or 1.8 per cent. of that of the sewage.
Chlorine,	8.46.
Nitrates,	1.5100.
Nitrites,	0.0022.
Bacteria per cubic centimeter,	21,038.

The quantity filtered was again increased. The average quantity for the next two months was 102,000 gallons per acre per day, and we have the following very satisfactory average analysis: —

Free ammonia,	0.0143, or 0.7 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0223, or 4 per cent. of that of the sewage.
Sum of ammonias,	0.0366, or 1.3 per cent. of that of the sewage.
Chlorine,	6.24.
Nitrates,	1.0562.
Nitrites,	0.0003.
Bacteria per cubic centimeter,	12,334.

This sand is, at the end of its third year of use, filtering about double the quantity filtered at the end of the second year, with a rather purer effluent. The better result is attributed to raking over the surface, to the depth of one inch, once a week.

Filter Tank No. 2.

This filter of very fine sand was allowed to stand through a part of November, 1889, without receiving sewage, and on November 26 the surface was spaded under to the depth of four inches. From November 29 to December 13 city water was applied to the tank instead of sewage, till the chlorine of the effluent was reduced to 0.19 parts per 100,000, — nearly the same as in city water. The application of sewage was resumed December 14, and it was found that the increase in chlorine indicated that sewage began to reach the bottom in small amount on December 20, after 1,780 gallons had passed through; that is, that these forward particles had passed by about 500 gallons of water held in the smaller interstices. A slight increase in the number of bacteria when about 40 gallons less had passed through appears to have been a somewhat more delicate test of the presence at the outlet of the most forward particles of the sewage. The effluent had the full strength of the chlorine of the sewage when 2,800 gallons had passed out, after the first sewage was applied at the surface. But, before this, when the chlorine of the effluent was but one-half that of the sewage, the nitrates of the effluent increased in one day from 0.2300 parts to 1.3500 parts per 100,000; indicating that, although nitrification had been reduced by the passing of city water through the filter, — for the reason that there was little organic matter to be nitrified, — the conditions for nitrification had not been lessened; so that, as soon as organic matter was presented, it oxidized very rapidly, and increased the nitrates to a larger percentage of the total nitrogen than usual.

The nitrates continued high through the winter, averaging 1.072 parts for the next two months, and then increased through March and April and to the middle of May, when they were 2.750 parts. In the first three months, January to March, with the usual quantity of 42,000 gallons per acre filtering daily, the ammonias were higher than usual; the free ammonia averaged 0.0205 parts, and the albuminoid ammonia 0.0119 parts, making the sum of ammonias 0.0324 parts per 100,000, or 1.5 per cent. of those of the sewage.

From April 9 to June 28, while the same quantity was filtering, the sum of ammonias was only 0.0130 parts, or 0.6 of one per cent. of those of the sewage; the free ammonia averaged 0.0016 parts, and the albuminoid ammonia 0.0114 parts. The nitrates decreased steadily from the middle of May to the last of June, from 2.750 parts to 1.000 part. Then the surface of the tank was raked over to the depth of one inch, and the nitrates, in one week, rose to 2.500 parts, and continued between this amount and 1.530 parts for the following three months. These higher nitrates were undoubtedly due to raking over the surface of the filter once a week.

With the first of July, the quantity of sewage applied was increased to 700 gallons, applied three days in a week, or an average rate of 60,000 gallons per acre per day. The sum of ammonias increased slightly for the first month, but afterwards steadily decreased, as follows: July, 0.0142 parts; August, 0.0130 parts; September, 0.0113 parts; and October, 0.0083 parts. In the last month they formed but 0.3 of one per cent. of those of the sewage.

The average analysis of the effluent for the last month was as follows: —

Free ammonia, . .	0.0004, or 0.02 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0079, or 1.2 per cent. of that of the sewage.
Sum of ammonias, .	0.0083, or 0.3 of one per cent. of that of the sewage.
Chlorine, . . .	5.37.
Nitrates, . . .	1.4140, or 51 per cent. of the total nitrogen of the sewage.
Nitrites, . . .	0.0000.
Bacteria per cubic centimeter,	17.

This is a very satisfactory result for this material. Two years before, we found it necessary to reduce the quantity of sewage to 200 gallons, applied three times a week, before we could obtain such purification. A year ago we obtained nearly as good an effluent with this filter when six-tenths as much sewage was filtering. The ability to filter the increased quantity at this time is believed to be entirely due to raking over the surface of the filter to the depth of an inch once a week, which has been done since the latter part of June, 1890.

Filter Tank No. 3A.

The peat which filled Tank No. 3 for two years was removed on Nov. 14, 1889, and on November 20 the tank was filled, above the gravel and sand around the underdrains, with a depth of 2.5 feet of fine sand like that in Tank No. 2, above which was 2.5 feet of coarse sand like that of Tank No. 1. The name was changed to Tank No. 3A. Five hundred gallons of water were applied to this tank daily for about a month, and on Jan. 6, 1890, the first sewage was applied. The quantity of sewage applied was 150 gallons a day, except Sundays, until June 30; then 300 gallons a day until September 7; then 350 gallons a day until October 20, when the quantity was increased to 500 gallons a day.

The nitrates of the effluent continued from 0.010 parts to 0.020 parts until March 20; when, the temperature of the effluent being at 38° Fah , the nitrates increased to 0.040 parts, after which they increased, slowly at first and then more rapidly, until the middle of May, when they were 3,750 parts. They then decreased, and in the latter part of June were 2,000 parts. From this time to September 7 they averaged 1.870 parts, and from September 7 to October 20 the average was 1.490 parts per 100,000.

Previous to the beginning of nitrification the free ammonias of the effluent increased to 0.6000 parts per 100,000, and the albuminoid ammonias to 0.0500 parts. The sum of ammonias were then 40 per cent. of those of the sewage; but the albuminoid ammonia was but 12 per cent. of that of the sewage.

While the nitrates were the highest, in the middle part of May, the total nitrogen coming from the tank was 40 per cent. more than was being applied. The ammonias were rapidly decreasing, and on June 19 their sum was less than one per cent. of the sum of ammonias in the sewage. The quantity of sewage applied was doubled after June 30, and the surface was raked over to the depth of one inch once a week. The ammonias, at first higher, gradually decreased through the month of July; and from August 1 to September 7 there was a steady and very complete purification.

The average analysis was as follows: —

Free ammonia, . .	0.0037, or 0.2 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0092, or 1.4 per cent. of that of the sewage.
Sum of ammonias, .	0.0129, or 0.5 of 1 per cent. of that of the sewage.
Chlorine, . . .	7.17.
Nitrates, . . .	1.9200.
Nitrites, . . .	0.0004.
Bacteria per cubic centimeter,	1,642.

With the increase in quantity of sewage applied after September 7 to 60,000 gallons per acre per day, the free ammonia increased until it became 0.0322 parts; but in the following three weeks it steadily decreased, until the analysis on October 16 was as follows: —

Free ammonia,	0.0026, or 0.1 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0082, or 1 per cent. of that of the sewage.
Sum of ammonias,	0.0108, or 0.4 of 1 per cent. of that of the sewage.
Chlorine,	4.94.
Nitrates,	1.1000.
Nitrites,	0.0000.

Bacteria per cubic centimeter, 3,960.

After this the daily quantity applied was increased to 100,000 gallons per acre, for six days in the week, which will be continued through the winter.

Filter Tank No. 4.

This filter, of extremely fine sand, has, since June, 1889, received sewage through a trench of coarse sand. The excellent results obtained in October, 1889, have continued. The equivalent of 26,000 gallons of sewage a day upon an acre has been continued through August, 1890; and the quality of the effluent has been very nearly constant through winter and summer; the principal variation being in the nitrates, which were as usual higher in April, May and June.

The average analysis for the ten months, November, 1889, to August, 1890, was as follows: —

Free ammonia,	0.0017, or 0.1 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0120, or 1.8 per cent. of that of the sewage.
Sum of ammonias,	0.0137, or 0.6 of 1 per cent. of that of the sewage.
Chlorine,	5.36.
Nitrates,	1.3337.
Nitrites,	0.0001.

Bacteria per cubic centimeter, 184.

This result was so satisfactory that the daily quantity of sewage was, on September 8, increased to 34,200 gallons per acre, and the average analysis for the following three months was as follows: —

Free ammonia,	0.0011, or 0.05 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0118, or 1.7 per cent. of that of the sewage.
Sum of ammonias,	0.0129, or 0.5 of 1 per cent. of that of the sewage.
Chlorine,	5.98.
Nitrates,	1.0854.
Nitrites,	0.0000.

When sewage was applied to the surface of this material, we were unable to obtain as good results as the above; and it was not till the quantity filtered was reduced to 12,000 gallons per acre per day that purification became nearly as complete as the results now obtained by applying to the coarse sand in the trench 34,200 gallons per acre per day.

Filter Tank No. 5.

This tank of garden soil, five feet deep, had a trench dug two and a half feet deep and one and a half feet wide, its outer edge being one and a half feet inside of the periphery. This trench was filled with coarse sand like that of Tank No. 1, and sewage has since been applied to this sand. The quantity applied has been 100 gallons, three times a week, from November, 1889, to September, 1890, or the equivalent of 8,600 gallons per acre per day. The quantity of effluent was a little greater, owing to the rain, in the first eight months; but during the last three months was less, on account of greater evaporation.

No nitrates were found in the effluent except for a short time in April, 1890, and again a few times in August and September. The sum of ammonias of the effluent was greater than that of the sewage, from November to January; but from February till near the end of August the sum of ammonias was nearly the same in each.

During the eleven months the free ammonia has averaged 2.8273, which is 68 per cent. more than the free ammonia of the applied sewage. But the albuminoid ammonia has averaged only 0.1869 parts, and has been very constantly 29 per cent. of that of the sewage.

While there has been little or no nitrification, there has been a marked reduction in the organic nitrogen, so that there remains but 29 per cent. of the amount in the sewage. This is only about one-third as much organic nitrogen as remained in the effluent when the sewage was applied directly to the surface of the filter, before the sewage was applied to the trench filled with coarse sand. This is a step in purification, but a very incomplete one, compared with the result in all of the sand filters.

After October 3 the quantity of sewage applied was reduced to 50 gallons, applied three times a week, or the equivalent of 4,300 gallons per acre per day, which is but little more than the rainfall upon the same area.

Filter Tank No. 6.

This tank, of coarse and fine sand and fine gravel, four feet deep, continued to receive 42,600 gallons daily per acre from June, 1889, to Sept. 8, 1890. In 1890 nitrification was continually active. It was most complete in April, May and August, when the nitrates exceeded 2.0 parts per 100,000. In December, 1889, the free ammonia increased for a time up to 0.0650 parts, but soon fell to 0.0068 parts.

The average analysis from January to August, 1890, was as follows: —

Free ammonia, . .	0.0028, or 0.16 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0181, or 2.7 per cent. of that of the sewage.
Sum of ammonias, .	0.0209, or 0.9 of 1 per cent. of that of the sewage.
Chlorine, . . .	5.54.
Nitrates, . . .	1.4125.
Nitrites, . . .	0.0002.
Bacteria per cubic centimeter,	7,144.

After Sept. 8, 1890, the quantity of sewage applied daily was increased to the equivalent of 60,000 gallons per acre, and the resulting analysis for the following three months was as follows: —

Free ammonia, . .	0.0030, or 0.15 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0164, or 2.4 per cent. of that of the sewage.
Sum of ammonias, .	0.0194, or 0.7 of 1 per cent. of that of the sewage.
Chlorine, . . .	5.50.
Nitrates, . . .	1.2627.
Nitrites, . . .	0.0001.
Bacteria per cubic centimeter,	10,044.

The surface of this filter has not been worked over or in any way disturbed for nearly three years. There is very little sediment upon the surface, but experience with other filters indicates that better results will be obtained if the surface be raked over once a week; and, although the results with this filter, having but four feet in depth of filtering material, have been remarkably good, in making a further increase of quantity the surface will be periodically disturbed.

Filter Tank No. 7.

This filter has a covering of soil and of loam, but the sewage has, since October, 1889, been applied in an open-jointed drain pipe beneath the loam. The drain pipe is surrounded with coarse gravel, which extends one foot and a half below it, and for a width of two feet.

From September, 1889, to August, 1890, 150 gallons of sewage were applied daily on six days in the week, or 25,700 gallons per day per acre.

For the ten months, November, 1889, to August, 1890, nitrification has been active. The nitrates have not been as high as with the sand filters, but have averaged 1.1544 parts per 100,000. The ammonias have been nearly constant.

The average analysis for the ten months was as follows: —

Free ammonia, .	0.0024, or 0.1 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0,0111, or 1.7 per cent. of that of the sewage.
Sum of ammonias,	0.0135, or 0.6 of 1 per cent. of that of the sewage.
Chlorine, . . .	5.49.
Nitrates, . . .	1.1544.
Nitrites, . . .	0.0001.
Bacteria per cubic centimeter,	501.

After Sept. 7, 1890, the quantity of sewage applied was increased to 200 gallons per day, for six days in the week, or the equivalent of 34,280 gallons per acre per day.

This quantity, for a time, was too much for the filter to purify, and, at the end of October, the free ammonia had increased to 0.1920 parts; the albuminoid ammonia was 0.0200 parts; the nitrates had been reduced to 0.4500 parts, but had again risen to 0.9000 parts; and the nitrites were 0.0110 parts.

From this time the effluent steadily improved, and on December 11 the analysis was as follows: —

Free ammonia,	0.0082
Albuminoid ammonia,	0.0084
Sum of ammonias,	0.0166
Chlorine,	4.34
Nitrates,	0.8900
Nitrites,	0.0009

Filter Tank No. 14.

During the summer of 1889 this tank of coarse sand, like that of No. 1, had sewage applied at the rate of 60,000 gallons per acre for six days in the week. The tight cover was kept on all of the time, and air was admitted at first for fifteen minutes a day, then for five minutes, then for three minutes, and finally for one minute. The air was kept in motion through the tank by means of an aspirator. Nitrification was nearly complete, and during the last month of October, 1889, when air was admitted in small quantity only, for one minute a day, the average analysis was as follows:—

Free ammonia,	0.0011
Albuminoid ammonia,	0.0129
Chlorine,	4.87
Nitrates,	1.4133
Nitrites,	0.0034

For the next month no air was admitted, but the aspirator continued running, causing the air within the tank to circulate through the sand. The nitrification was as complete, and the removal of organic matter nearly as great, as in the previous month. It was evident that oxygen must have been supplied from some source; and it was concluded that it came, in very small amount, from the absorbed oxygen of the water of the aspirator, which continually came in contact with the air which it was causing to circulate.

On December 7 the aspirator was removed. Nitrification rapidly decreased; and through January and the most of February the nitrates and nitrites were zero. The free ammonia rose to 1.4, and the albuminoid ammonia to 0.13, parts.

On March 10, 1890, the cover was removed, and on March 21 the nitrates had risen to 2.6 parts. The ammonias rapidly decreased, and at the end of April there was a well-established purification. For the next month and a half the analyses averaged as follows: free ammonia, 0.0033; albuminoid ammonia, 0.0153; chlorine, 4.84; nitrates, 2.6643; nitrites, 0.0011.

After the middle of June, the quantity of sewage was increased to the equivalent of 100,000 gallons per acre, for six days in the week. The free ammonias rose for a few days, and then fell to their former amount. The albuminoid ammonias increased permanently. The average analysis for the three months July, August and September, 1890, was as follows :—

Free ammonia, .	. 0.0043, or 0.2 of 1 per cent. of that of the sewage.
Albuminoid ammonia,	0.0240, or 4 per cent. of that of the sewage.
Sum of ammonias,	. 0.0283, or 1 per cent. of that of the sewage.
Chlorine, . .	. 6.63.
Nitrates, . .	. 2.3425.
Nitrites, . .	. 0.0008.

This was a very good result when filtering so large a quantity.

In October a little sewage remained on the surface in spots, in the first half of the month, and the ammonias increased; but, upon raking over the surface—which had not been disturbed for six months—to the depth of one inch, once a week, the nitrates again increased, and for the month of November the ammonias were the same as in the analysis just given, with no indication that this quantity may not be as well purified for an indefinite period.

On Dec. 4, 1890, the daily quantity of sewage was increased to 120,000 gallons per acre, for six days in the week.

Filter Tank No. 15a.

This tank, of coarse gravelstones, has been treated with the equivalent of 20,000 gallons per acre, for six days in the week, of sewage having an excess of acid, made so by adding to ordinary sewage varying amounts of sulphuric acid.

From Nov. 4, 1889, to May 8, 1890, the amount of sulphuric acid added was 22.54 parts per 100,000. From May 9 to July 30 the amount was 45 parts per 100,000; and from July 31 to October 26 the amount added was 90 parts per 100,000. The object was to see the effect of intermittent filtration of sewage having an excess of sulphuric acid. It will be seen that, while purification was much less than with alkaline sewage, there was at all times some nitrification, and the organic nitrogen was very much reduced.

The average analysis of the effluent in the first four months of the year, while the smaller quantity was added, was as follows: —

Free ammonia, .	. 1.4881, or 102 per cent. of that of the sewage.
Albuminoid ammonia,	0.0884, or 13 per cent. of that of the sewage.
Sum of ammonias,	. 1.5765, or 73 per cent. of that of the sewage.
Chlorine, . .	. 4.93.
Nitrates, . .	. 0.0930.
Nitrites, . .	. 0.0016.

In the second period, when 45 parts per 100,000 of sulphuric acid were added to the sewage, the average analysis for three months was as follows: —

Free ammonia, .	. 2.8425, or 142 per cent. of that of the sewage.
Albuminoid ammonia,	0.1468, or 22 per cent. of that of the sewage.
Sum of ammonias,	. 2.9893, or 113 per cent. of that of the sewage.
Chlorine, . .	. 7.45.
Nitrates, . .	. 0.0932.
Nitrites, . .	. 0.0009.

In the third period, from July 31 to Oct. 26, 1890, when 90 parts per 100,000 of sulphuric acid were added, we have the following average analysis: —

Free ammonia, .	. 2.3983, or 114 per cent. of that of the sewage.
Albuminoid ammonia,	0.1582, or 24 per cent. of that of the sewage.
Sum of ammonias,	. 2.5515, or 93 per cent. of that of the sewage.
Chlorine, . .	. 8.17.
Nitrates, . .	. 0.0311.
Nitrites, . .	. 0.0004.

While there has been a small amount of nitrification through the year, which has decreased with the great excess of acid of the last three months, there has been a continued removal of more than three-quarters of the organic nitrogen, as shown by the albuminoid ammonia.

Filter Tanks No. 17A and No. 19.

These two iron tanks, in the building, were, on Jan. 25, 1890, filled with sand intermediate in fineness between that of No. 1 and that of No. 2. The sand of each was taken from the same pit, and is presumed to be of like quality; but, in filling No. 17A, marble dust was added in layers containing ten pounds, or having a depth of a little more than one-half inch, at distances of one, three and four feet, and of four feet and nine inches from the top of the layer of coarse sand on the gravel at the bottom. The upper layer of marble dust was covered with three inches of sand.

These two filters were treated alike for nine months, to see if there was any advantage, when filtering an ordinary alkaline sewage, in having layers of an alkaline earth in the filter.

Sewage was applied to each on Jan. 28, 1890, the quantity being 1.5 gallons on week days, until February 18, after which it was 3 gallons, or at the rate of 60,000 gallons per acre.

The nitrates were a little higher in No. 19 during the first month, and they rose rapidly in this tank fifteen days earlier than in Tank No. 17A. Perhaps this was due to more freedom of motion of air through the tank which contained no marble dust.

The nitrates were high in both filters after May 1; but were a little higher in the tank without the marble dust.

The average analysis in each for the following six months was as follows: —

	Tank No. 17A.	Tank No. 19.
Free ammonia,	0.0026	0.0055
Albuminoid ammonia,	0.0130	0.0110
Sum of ammonias,	0.0156	0.0165
Chlorine,	5.84	5.73
Nitrates,	2.0219	2.2492
Nitrites,	0.0009	0.0029
Bacteria per cubic centimeter,	25.	35.

No advantage appears in favor of the addition of marble dust in this trial of nine months with ordinary alkaline sewage. After Oct. 26, 1890, Tank No. 17A was treated with sewage to which a definite amount of sulphuric acid was added, and the quantity of sewage applied to Tank No.

19 was increased to the equivalent of 120,000 gallons per acre, on six days in the week.

Filter Tank No. 25.

This iron tank, 20 inches in diameter and 12.2 feet high, had the usual gravel and coarse sand put in at the bottom for a depth of six inches, above which was five feet of sand and loam from a cemetery. Water was filtered through this sand and loam for three months, when the resulting effluent gave the following analysis: free ammonia, 0.0014; albuminoid ammonia, 0.0024; chlorine, 0.23; nitrates, 0.0250; and nitrites, 0.0002 parts per 100,000.

On Dec. 18, 1889, the carcass of a dog, weighing eleven and a half pounds, was put on the surface, and this was covered with six feet of sand and loam similar to that below.

From Jan. 1, 1890, to November 21, one and a half gallons of water were poured upon the surface each week. This is a little more than the average weekly rainfall upon such a surface. The changes that occurred in the effluent from month to month are presented in the following table of monthly averages of analyses of the effluent: —

Date.	Ammonia.			Chlorine.	Nitrogen as		Bacteria per Cubic Centimeter.
	Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.	
1889.							
October 30,	.0014	.0024	.0038	.23	.0250	.0002	–
December,	.0100	.0161	.0261	3.11	.0280	.0004	–
1890.							
January,	.0065	.0044	.0109	6.26	.0275	.0001	–
February,	.0033	.0043	.0076	7.30	.0225	.0010	–
March,	.0031	.0082	.0113	8.21	.0125	.0000	–
April,	.0037	.0114	.0151	9.21	.0050	.0002	–
May,	.0034	.0153	.0187	7.47	.0200	.0000	–
June,	.0033	.0214	.0247	4.67	.0350	.0000	–
July,	.0878	.0178	.1056	3.23	.1700	.0050	–
August,	1.6990	.0394	1.7384	2.52	.8500	.1850	–
September,	6.5350	.0461	6.5811	1.85	.7750	.0617	4,319
October,	11.4250	.6850	12.1100	1.76	.1475	.0271	18,360
November,	26.6250	2.8000	29.4250	1.49	.0925	.0082	4,796

The chlorine increased in four months from 0.23 parts — which was that of the water going through the lower five feet before the carcass was buried — to 9.21 parts; and then gradually decreased in seven months to 1.49 parts per 100,000 of the water coming through.

The nitrates were no higher than the water applied, for six months; that is, in this time there was no nitrification, but in the next two months the nitrates increased to 0.8500 parts, and then gradually fell in three months to 0.0925 parts. It may be that this small amount of nitrification took place in the lower layers of the tank where air was received from the outlet. In future the outlet will be trapped so that no air can enter there, to determine whether air permeates this material from the surface to sufficient depth to produce nitrification of organic matter six feet below the surface.

The nitrites increased with the nitrates to 0.1850 parts, and decreased to 0.0082 parts in November.

The free ammonia was low and nearly constant, at about 0.0034 parts, for six months, and then increased at a very rapid rate in the remaining five months to 26.6250 parts, in November.

The albuminoid ammonia increased but little for seven months, and then slowly for two months; after which it increased very rapidly, and for November averaged 2.8000 parts per 100,000.

The odor of the effluent grew very strong and offensive through April, May and June, and was the most nauseating the first week in July, since which it has decreased much, but is still strong.

Filter Tanks No. 26 to No. 31.

These six tin tanks are smaller than the iron tanks, being but 2.95 feet deep and 1.41 feet in diameter. Each is filled with filtering material to the depth of 2.5 feet, which, with the 0.25 foot of gravel at the bottom, makes a total depth of 2.75 feet.

Tanks No. 26 and No. 29 were filled with washed gravel-stones that would not go through a sieve having meshes five-eighths of an inch square.

Tanks Nos. 27 and 30 were filled 2.5 feet deep with sand like that of Tank No. 1, and Tanks Nos. 28 and 31 were filled to the same depth with a finer sand like that of Tank No. 19.

The first named in each of these couples was first treated with sewage on April 1, 1890, when nitrification was active in all of the old tanks; and the second of each couple was first treated with sewage on May 27, after each of the first set had been rapidly nitrifying for two weeks. The object was to determine upon what the beginning of nitrification depended, — whether temperature, season of the year, or quantity of stored nitrogen.

When the first series was started, April 2, Tank No. 3A, which was started in January, had been increasing in nitrates for two weeks, having begun when its temperature was at 38° Fah. This is within two degrees of the temperature when all of our tanks, started in the winter, have begun to nitrify. The temperature of the effluent of this series was 46° at the start, but the nitrates did not increase until three or four weeks later, when the temperature was 53°.

This delay in nitrification was not, then, on account of the low temperature, nor was it entirely due to the season of the year; for No. 3A, beginning to nitrify in March, had nitrates 1.0 part in 100,000 ten days to two weeks before this series; and Tanks Nos. 2, 3, 4, 6 and 7 were increasing rapidly in nitrates before this series commenced.

There appears to be required at this very favorable season of the year for nitrification, with temperatures of effluent of about 53°, the accumulation of nitrogenous matter in the filter, or, it may be, an accumulation of nitrifying bacteria throughout the filter, before nitrification begins to increase.

In both series nitrification began a little earlier in the filter of No. 1 sand than in that of the finer sand, and in this a very little earlier than with the gravel. The latter had in each case been washed, and possibly the conditions within the material modified thereby.

Comparing the results obtained with the two series, the latter member of each couple starting eight weeks after the former, we have the following data in each, up to the time when nitrates began to increase rapidly: —

	Number of days after the first Sewage was applied.	Amount of Nitrogen applied in the Sewage. Pounds.	Amount of Nitrogen which came off in the Effluent. Pounds.	Difference, or Amount of Nitrogen stored in the Filter. Pounds.	Temperature of Effluent. Fah.
No. 26, ...	26	0.0023	0.0005	0.0018	54°
No. 29, ...	11	0.0010	0.0001	0.0009	66°
No. 27, ...	22	0.0078	0.0016	0.0062	52°
No. 30, ...	8	0.0030	0.0004	0.0026	61°
No. 28, ...	26	0.0090	0.0020	0.0070	54°
No. 31, ...	8	0.0030	0.0003	0.0027	61°

We see that in the latter series, with the temperature of the effluent at 63°, the number of days after sewage was first applied was between one-half and one-third as many, and the amount of nitrogen stored was between one-half and one-third as much, as in the former series, when the temperature was 53°.

In both cases, and in all other cases, we have found that some stored nitrogen is necessary, before nitrification begins to be active; and that the amount required is less in warm weather than in cold. It may be that the warmer season is also more favorable for the accumulation of nitrifying bacteria. When the conditions for high nitrification are established, we have found the nitrification continues as complete through the cold season as at other times in the year, except in the months when vegetation grows most rapidly, and nitrification is exceptionally high.

After nitrification was well established in these two sets of tanks, — which in the first set was in the middle of May, and in the second the middle of June, — some time was required for the removal of organic matter before they reached an established condition of purification.

In the tanks filled with gravel, the sum of ammonias in the effluent of No. 26 in June was 2 per cent. of those in the sewage, and in July the sum of ammonias of both No 26 and No. 29 were but one and one-quarter per cent. of those of the sewage. Up to this time the amount of sewage filtered daily was at the rate of 10,000 gallons per acre.

After July 24, the quantity filtered was 20,000 gallons per acre per day, applied in nine hourly portions.

The average results in the month of August were as follows : —

	Free Ammonia.	Albuminoid Ammonia.	Sum of Ammonias.	Chlorine.	Nitrates.	Nitrites.	Number of Bacteria per Cubic Centimeter.
Sewage,	2.4228	0.7786	3.2014	9.64	0.0000	0.0000	1,931,000
Effluent No. 26,	0.0075	0.0260	0.0385	9.01	1.4250	0.0008	18,316
Per cent.,	0.3 of 1	3.	1.	–	–	–	1.
Effluent No. 29,	0.0049	0.0169	0.0218	8.82	1.6625	0.0013	9,923
Per cent.,	0.2 of 1	2.	0.7 of 1	–	–	–	0.5 of 1

This quality of effluent continued nearly the same through September, with the exception of an increase in albuminoid ammonia of No. 26. In October and November the results were not so good; but, with a continuance of 20,000 gallons of sewage per acre per day, these filters of gravel-stones only two feet and nine inches deep, without having the surface disturbed for eight and seven months, gave effluents containing only four and three per cent. of the organic matter of the sewage, as shown by the sum of ammonias.

Tanks No. 27 and No. 30, of sand like No 1, 2.5 feet deep, came into a condition of reasonable purification in two weeks and one week respectively, after reaching the most active nitrification. Then their effluents contained about two and one per cent. of the organic matter of the sewage, as shown by the sum of ammonias. But this condition was not permanent, while the equivalent of 40,000 gallons per acre was applied at once on each of six days in the week; and in the third week in July the sum of ammonias of the effluent amounted to near thirty per cent. of those of the sewage; but, by changing the method of application of the sewage to the equivalent of 10,000 gallons four times a day, — on July 24, — the quality of the effluent was immediately improved, and through August and September we have the following excellent results : —

	Free Ammonia.	Albuminoid Ammonia.	Sum of Ammonias.	Chlorine.	Nitrates.	Nitrites.	Number of Bacteria per Cubic Centimeter.
Sewage,	2.1764	0.6583	2.8347	7.21	0.0000	0.0000	1,249,000
Effluent No. 27,	0.0046	0.0197	0.0243	8.12	1.9125	0.0002	5,705
Per cent.,	0.2 of 1	3.	0.9 of 1	–	–	–	0.5 of 1
Effluent No. 30,	0.0049	0.0112	0.0161	8.78	1.9687	0.0005	582
Per cent.,	0.2 of 1	1.7	0.6 of 1	–	–	–	0.05 of 1

This was a remarkably good result for 40,000 gallons a day filtering through a depth of 2.5 feet of coarse sand. More than 99 per cent. of the organic matter, and a still larger fraction of the bacteria, were removed by the process of nitrification.

In October the result was not quite so good, as some sewage remained on the surface; but, upon raking over the surface once a week, the effluents again improved to the condition of August and September.

Tanks No. 28 and No. 31, of finer sand, 2.5 feet deep, filtering at the rate of 40,000 gallons per acre per day for six days in the week, purified in July to the extent of removing 99.3 per cent. of the sum of ammonias of the sewage; and, after changing the method of application to four charges daily,— on July 24, — we have the following average results for August: —

	Free Ammonia.	Albuminoid Ammonia.	Sum of Ammonias.	Chlorine.	Nitrates.	Nitrites.	Number of Bacteria per Cubic Centimeter.
Sewage,	2.4228	0.7786	3.2014	9.64	0.0000	0.0000	1,931,000
Effluent No. 28,	0.0042	0.0168	0.0210	11.84	2.0625	0.0000	70
Per cent.,	0.2 of 1	2.	0.7 of 1	–	–	–	0.004 of 1
Effluent No. 31,	0.0089	0.0150	0.0239	9.41	2.3125	0.0026	62
Per cent.,	0.4 of 1	2.	0.7 of 1	–	–	–	0.003 of 1

For a short time in October the surface of Tank No. 31 was continually covered with sewage, but after the middle of the month both tanks had their surface raked over once a week, and a condition similar to that of August continues.

It is evident that shallow filters, 2.5 feet deep, require more attention to the condition of the surface than those of greater depth; but the very complete nitrification and removal of organic matter of the past six months show that, with proper care, they may serve a very useful purpose.

INTERMITTENT FILTRATION OF WATER.

The experiments upon the intermittent filtration of water have been continued another year, with interesting results.

With filters of coarse sand, we have filtered intermittently the equivalent of from 200,000,000 to 300,000,000 gallons on an acre, giving an entirely colorless and satisfactory effluent. After these amounts were filtered, the effluent continued to be much improved, but the color was not entirely removed, and gradually increased. Upon reducing the quantity daily filtered, and allowing more air to enter the sand, the color was reduced, as well as the organic nitrogen; and we are seeking the best method of treatment by which the active life of such a filter may be lengthened.

With filters of coarse sand, having a layer of loam, or fine sand, we find the quantity that will pass through is limited; but, with 300,000 gallons a day per acre continued for three years, we have entirely satisfactory results.

Filter Tank No. 8.

This large tank in the field, filled with fine gravel and coarse and fine sand, with a layer of loam eight inches deep, having its upper surface six inches below the top of the filter, has continued, through the year, to filter 1,500 gallons of city water applied daily on six days of the week. This is the equivalent of 300,000 gallons daily per acre for six days in the week.

This filter has been filtering city water constantly for three years, giving an entirely colorless effluent. The total quantity filtered is the equivalent of 206,000,000 gallons on an acre.

The average analysis of the effluent for the year 1890, to the end of November, is as follows: —

Free ammonia, . .	0.0007, or 41 per cent. of that of applied water.
Albuminoid ammonia,	0.0056, or 45 per cent. of that of applied water.
Sum of ammonias, .	0.0063, or 44 per cent. of that of applied water.
Chlorine, . . .	0.17.
Nitrates, . . .	0.0239, or 134 per cent. of that of applied water.
Nitrites, . . .	0.0000.

Number of bacteria per cubic centimeter, 56, or 47 per cent. of the number found in the applied waters.

The average analyses for each month, of both city water and effluent, are given in the following table: —

Monthly Averages of Results with Filter Tank No. 8, for 1890.

DATE.		Quantity of Effluent. Gallons.	RESIDUE ON EVAPORATION.		AMMONIA.			Chlorine.	NITROGEN AS		Temperature.	Number of Bacteria per Cubic Centimeter.
			Loss on Ignition.	Fixed.	Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.		
1890.												
Dec. 31, '88–Jan. 30, '89,	City water,	–	1.15	2.55	.0011	.0105	.0116	.19	.0120	.0000	39°	53
January,	Effluent,	899	.90	2.42	.0004	.0059	.0063	.19	.0230	.0000	39°	6
	Per cent.,	–	78	95	40	56	54	–	192	–	–	–
Jan. 31–Feb. 27,	City water,	–	1.00	2.47	.0015	.0108	.0123	.18	.0150	.0000	36°	175
February,	Effluent,	1,072	.92	2.55	.0009	.0055	.0064	.18	.0205	.0000	36°	17
	Per cent.,	–	92	103	60	51	52	–	137	–	–	–
Feb. 28–Mar. 30,	City water,	–	.95	2.32	.0029	.0125	.0154	.17	.0140	.0000	40°	148
March,	Effluent,	273	.82	2.60	.0008	.0071	.0079	.17	.0210	.0000	39°	4
	Per cent.,	–	86	112	28	57	51	–	150	–	–	–
Mar. 31–Apr. 29,	City water,	–	1.28	2.54	.0017	.0128	.0145	.16	.0144	.0000	42°	–
April,	Effluent,	761	.96	2.70	.0010	.0067	.0077	.15	.0286	.0000	45°	9
	Per cent.,	–	75	106	60	52	53	–	129	–	–	–
Apr. 30–May 30,	City water,	–	1.03	2.20	.0013	.0118	.0131	.13	.0175	.0000	51°	–
May,	Effluent,	971	.80	2.60	.0010	.0059	.0069	.13	.0335	.0000	56°	7
	Per cent.,	–	77	118	77	50	53	–	191	–	–	–
May 31–June 29,	City water,	–	–	–	.0019	.0140	.0159	.13	.0160	.0000	58°	33
June,	Effluent,	1,129	–	–	.0010	.0066	.0076	.13	.0240	.0000	64°	3
	Per cent.,	–	–	–	53	47	48	–	150	–	–	–
June 30–July 30,	City water,	–	–	–	.0020	.0132	.0152	.20	.0264	.0000	67°	106
July,	Effluent,	1,267	–	–	.0005	.0044	.0049	.20	.0260	.0000	71°	5
	Per cent.,	–	–	–	25	33	32	–	100	–	–	–
July 31–Aug. 30,	City water,	–	–	–	.0032	.0152	.0184	.22	.0232	.0000	70°	97
August,	Effluent,	1,213	–	–	.0010	.0058	.0068	.22	.0232	.0000	73°	572
	Per cent.,	–	–	–	31	38	37	–	100	–	–	–
Aug. 31–Sept. 29,	City water,	–		–	.0017	.0128	.0145	.18	.0230	.0000	66°	148
September,	Effluent,	1,195	–	–	.0005	.0050	.0055	.18	.0218	.0000	68°	3
	Per cent.,	–	–	–	30	39	38	–	95	–	–	–
Sept. 30–Oct. 30,	City water,	–	–	–	.0007	.0127	.0134	.17	.0146	.0000	58°	181
October,	Effluent,	1,036	–	–	.0003	.0036	.0039	.18	.0187	.0000	57°	7
	Per cent.,	–	–	–	43	28	29	–	128	–	–	–
Oct. 31–Nov. 29,	City water,	–	–	–	.0007	.0114	.0121	.16	.0212	.0000	49°	119
November,	Effluent,	825	–	–	.0005	.0048	.0053	.18	.0225	.0000	46°	3
	Per cent.,	–	–	–	71	42	44	–	106	–	–	–

The removal of organic nitrogen in the last three months is more complete than in the first three months, and is the same as in the corresponding three months of last year.

The number of bacteria in the effluent, in all but one month, has averaged six per cubic centimeter; and it is probable that none came down through the filter.

The effluent has been, as in the previous years, a clear, bright, colorless spring water.

Filter Tank No. 18A.

Filter Tank No. 18A is the iron tank formerly No. 18, which, in July, 1889, was refilled with coarse and fine gravelstones to the depth of three inches, above which was a depth of five feet of coarse sand like that of Tank No. 1.

From August 13 to September 17, this sand was treated with one gallon or one-half a gallon of water, containing aluminum sulphate on one day, and sodium carbonate the next, by which about nine ounces of alumina was precipitated within the sand and remained there.

After Oct. 5, 1889, no water was applied until Jan. 29, 1890; but from this time the equivalent of 1,000,000 gallons of city water a day, for six days in the week, was applied until the end of October, 1890. The water was applied at hourly intervals, in a little less than one minute, fourteen times a day. It disappeared from the surface immediately.

The color of the applied water was entirely removed until the last of September.

The monthly averages of analyses of the applied city water, and of the effluent, are contained in the following table: —

Monthly Averages of Results with Filter Tank No. 18A.

DATE.		Quantity of Effluent. Gallons.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.			Chlorine.	NITROGEN AS		Temperature.	Number of Bacteria per Cubic Centimeter.
				Fixed.	Loss on Ignition.	Free.	Albuminoid.	Sum of.		Nitrates.	Nitrites.		
1890.													
February,.	City water,	–	.30	1.00	2.47	.0015	.0108	.0123	.18	.0150	.0000	36°	175
February,.	Effluent, .	45	.00	.90	3.08	.0022	.0028	.0050	.18	.0198	Present.	43°	22
	Per cent., .	–	–	90	125	147	26	41	–	132	–	–	–
March, .	City water,	–	.30	.95	2.32	.0029	.0125	.0154	.17	.0140	.0000	40°	148
March, .	Effluent, .	44	.00	.52	2.32	.0022	.0057	.0079	.17	.0177	.0000	44°	246
	Per cent., .	–	–	55	100	76	46	51	–	126	–	–	–
April, .	City water,	–	.35	1.28	2.54	.0017	.0128	.0145	.16	.0144	.0000	42°	–
April, .	Effluent, .	43	.00	.74	2.14	.0014	.0053	.0067	.15	.0204	.0000	49°	139
	Per cent., .	–	–	58	84	82	41	46	–	142	–	–	–
May, . .	City water,	–	.23	1.03	2.20	.0013	.0118	.0131	.13	.0175	.0000	51°	–
May, . .	Effluent, .	44	.00	.70	2.27	.0005	.0067	.0072	.13	.0200	.0000	60°	270
	Per cent., .	–	–	68	103	38	57	55	–	114	–	–	–
June, .	City water,	–	.23	–	–	.0019	.0140	.0159	.13	.0160	.0000	58°	33
June, .	Effluent, .	42	.00	–	–	.0012	.0080	.0092	.13	.0235	.0000	67°	114
	Per cent., .	–	–	–	–	63	57	58	–	147	–	–	–
July, . .	City water,	–	.24	–	–	.0020	.0132	.0152	.20	.0264	.0000	67°	106
July, . .	Effluent, .	44	.00	–	–	.0011	.0068	.0079	.20	.0236	.0012	73°	26
	Per cent., .	–	–	–	–	55	52	52	–	88	–	–	–
August, .	City water,	–	.25	–	–	.0032	.0152	.0184	.22	.0232	.0000	70°	97
August, .	Effluent, .	42	.00	–	–	.0014	.0076	.0090	.23	.0190	.0008	73°	75
	Per cent., .	–	–	–	–	44	50	49	–	82	–	–	–
September,	City water,	–	.28	–	–	.0016	.0134	.0150	.17	.0208	.0000	66°	148
September,	Effluent, .	43	.02	–	–	.0008	.0081	.0089	.18	.0230	Present.	67°	35
	Per cent., .	–	7.1	–	–	50	60	59	–	111	–	–	–
October, .	City water,	–	.28	–	–	.0006	.0120	.0126	.17	.0152	.0000	58°	181
October, .	Effluent, .	41	.08	–	–	.0005	.0086	.0091	.18	.0193	.0000	56°	41
	Per cent., .	–	28	–	–	83	72	72	–	127	–	–	–
Average, .	City water,	–	.27	–	–	.0019	.0129	.0148	.17	.0181	.0000	54°	127
	Effluent, .	43	.01	–	–	.0013	.0066	.0079	.17	.0207	.0000	59°	107
	Per cent., .	–	–	–	–	68	51	53	–	114	–	–	–

During the nine months we see that the nitrates of the effluent have averaged higher than of the applied water by 14 per cent., although there were two months, July and August, when they were lower. The most of the water was, during the day, about three hours in passing through the sand, and this time has been sufficient for satisfactory nitrification to take place, although not so complete nitrification as with Tank No. 8. The free ammonia of the effluent has been 68 per cent. of that of the applied water, and the albuminoid ammonia has been reduced to 51 per cent. of that of the applied water.

The great reduction in the organic nitrogen, as shown by the albuminoid ammonia, and the conversion of this into nitrates, is the important step in purification, and this was much more completely accomplished in the first three months than in those that follow. In the first three months the albuminoid ammonia of the water was reduced from 0.0120 parts to 0.0046 parts, or to 38 per cent., while in the last three months it was reduced from 0.0135 parts to 0.0078 parts, or to 58 per cent. It was evident that, although this filter of very coarse sand, in which had been precipitated a small amount of alumina, had very satisfactorily filtered the equivalent of 234,000,000 gallons of water upon an acre in nine months, it was at that time deteriorating; and the sand will now be subjected to the precipitation, throughout its mass, of another small amount of alumina, to determine whether this is the element which enabled it to give so good results for so long a time.

The Laboratory Work.

The laboratory work at the Lawrence Experiment Station, during the past year, has consisted mainly of the examination of about two thousand samples of sewage, water and sand. A new laboratory building, completed in July, gives greatly improved facilities for work, and includes a well-equipped biological department.

During the year a few changes have been made in the methods of analysis, the most important of which are a greatly improved method of determining nitrates, and a more delicate method of measuring colors. The systematic determination of loss on ignition has been discontinued, and the determination of oxygen consumed from potassium permanganate has been adopted, a long series of experiments, given in the report now being published, having shown that the loss on ignition gives much too high results for organic matter, in presence of the high nitrates of our effluents, even when made with the use of sodium carbonate, and making deduction of the amount that the salts present would lose if quite free from organic matter. This additional loss is due to the fact that, in burning, the organic matter takes a portion of the oxygen, necessary for its combustion, from the nitrates present, reducing them to nitrites and carbonates. The loss in weight thus includes, with the organic matter, the weight of a large portion of the oxygen required for its combustion.

The oxygen consumed shows the relative quantities of oxidizable organic matter, but not its total amount. The comparative results are most satisfactory, being far more regular than the loss on ignition, and in general unaffected by the presence of large quantities of mineral matter.

By the aid of the new nitrate process, it has been found that there is no loss of nitrogen by the nitrification of an ammonia solution applied to sand; and very little, if any, loss in the presence of a large amount of common salt. In the presence of sugar, however, there is a considerable percentage of nitrogen unaccounted for, probably given off as free nitrogen; and it seems probable that the presence of carbonaceous substances, more or less similar to sugar, causes the loss of nitrogen which has been observed in sewage filtration.

The Biological Work.

The biological work of the Lawrence Experiment Station has been steadily continued throughout the year. A systematic and extended examination of the ice supplies of the Commonwealth was concluded early in the year, and forms a portion of a special report to the last Legislature.

During the summer of 1890 an investigation of the public wells of Massachusetts was undertaken, and many important facts were brought to light; but, for the full understanding and final sanitary interpretation of the results already obtained, it will be necessary to continue the work for at least another year.

Special studies of the micro-organisms of sewage have been made during the year, and, in part, brought to a successful conclusion. As a result, a number of important but hitherto obscure organisms have been fully studied, classified and photographed. Our knowledge of the true nature of sewage has thus been advanced, and a step taken which is important and necessary in making much-desired investigations upon the relations of disease germs to sewage.

The necessary preliminary steps have also been taken for a thorough examination of the behavior of the germ of typhoid fever in sewage and in drinking waters; and it is hoped that during the coming year highly important practical conclusions may be arrived at in this very important subject.

By the work of the past year new light has been thrown, also, upon the question of sewage purification, and the disposal of organic waste materials by soils and waters, in an elaborate series of experiments continued since the autumn of 1888 by the biologists and chemists of the Board. It has long been known that micro-organisms are the indispensable agents of this process of nitrification; but it is only within the year that a more intimate and specific knowledge of these organisms and the conditions of their activity have been obtained. During 1890, however, a single worker in France and two in England have announced great advances in this direction. Almost simultaneously the experts of the Board arrived at confirmatory results, the first of the kind obtained, as yet, in America. These results are presented in Part II. of Report on Water Supply and Sewerage, just issuing from the press.

RECOMMENDATIONS.

There are many questions concerning the periodical recurrence of disagreeable tastes and odors in some of the public drinking supplies of the State, and the effects of droughts and long-continued covering by ice of ponds and rivers, somewhat polluted by sewage, which, in the judgment of the Board, should be carefully studied in continuation of the work already accomplished.

The Board recommends the continuance of experiments upon intermittent filtration of surface waters and of sewage; the continuance of the work already commenced upon wells used by the public; and the investigation of the character of some of the spring waters that are sold in many of the cities.

For these purposes, and to make the necessary investigations in order to advise cities, towns, corporations and individuals in regard to the best method of assuring the purity of intended or existing water supplies, and the best method of disposing of sewage, and to carry out the other provisions of chapter 375 of the Acts of 1888, the Board estimates that the sum of $27,000 will be required.

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JULIUS H. APPLETON,
ELIJAH U. JONES,
JOSEPH W. HASTINGS,
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State Board of Health.

EXAMINATIONS OF WATER SUPPLIES AND RIVERS.

WATER SUPPLIES.

EXAMINATION OF WATER SUPPLIES.

EXPLANATORY NOTE.

The following tabulation, giving chemical and biological examinations of many of the sources of water supply in the State and a description of works completed in the latter part of 1889 and in 1890, is a continuation of a similar tabulation contained in Part I. of a special report of the Board on Water Supply and Sewerage, published in 1890. An alphabetical arrangement by towns has been adopted as in Part I. of the special report.

The chemical examinations given in this report were made in the same manner as heretofore; but a slight change is made in the form in which they are presented in the tables. In the special report the figures in common type indicated determinations made upon the water as received in the laboratory; that is to say, they included the suspended matters and sediment, while the figures in heavy-faced type indicated determinations made on the water after it had been filtered through paper. In the present volume, owing to the adoption of uniform rules regarding the filtration of the water and the re-arrangement of the form of the table, this distinction is rendered unnecessary. All waters containing suspended matter are now filtered before determining the residue on evaporation, and an additional column is provided in the tables to show the albuminoid ammonia as determined after filtering. This column is headed "dissolved albuminoid ammonia," and the figures in it correspond to those in heavy-faced type under the heading "albuminoid ammonia" in the special report.

Other changes have been made by adding one column to contain the hardness of the water, and another the suspended albuminoid ammonia which is found to have much significance and could only be obtained in the special report by subtracting the heavy-faced figures in the column of albuminoid ammonia from those in common type.

A few cases will be noted in the tabulated results in which one or more chemical determinations differ somewhat widely from others in the series. Such a condition of the water might result from floods or other unusual disturbance of a stream, or from carelessness in collection; or an error may have been made in the analysis. In such cases the determination has been underlined and has not been included in the average.

The color of waters is expressed by numbers, which increase with the amount of color. Water having a color of 1.0 is a decided yellowish-brown when seen in small bulk, as in a tumbler.

The tables contain analyses from June 1, 1889, to Dec. 31, 1890, a period of nineteen months, which includes two summers and autumns and only one spring. It is obvious that the average of monthly examinations for this time does not represent the mean yearly composition of the water; and this should be borne in mind in making comparisons with former averages which usually represented exactly one or two years of monthly observations.

In the microscopical examination of the waters a marked change has been made. In fact there has been from time to time a decided advance in the accuracy of the methods employed for determining quantitatively the number of organisms contained in the water.

The regular microscopical examination of all samples of water received at the laboratory was begun in March, 1888. At that time two hundred cubic centimeters of water were filtered through cloth, using the method described on pages 581 and 582 of Part I. of the special report. The different genera were determined and their relative abundance was ascertained approximately and indicated by the adjectives "few," "several," "abundant," and "very abundant."

After June 5, 1888, although the same method of filtration was used greater care was taken to determine the number of organisms of each kind removed from the two hundred cubic centimeters of water, and the results were recorded in figures showing the number found. The method of filtration adopted was defective in that it did not permit all of the organisms contained in the water to be transferred to the slide of the microscope for examination, and the figures do not, therefore, represent more than a part of the total number of organisms in two hundred cubic centimeters of water. This method was used until June 1, 1889, and consequently applies to all microscopical examinations recorded in Part I. of the special report.

The results tabulated in the present volume have been obtained in all cases by filtering the water through sand. Two methods have been used. The first was adopted on June 1, 1889, and was used without material change until Nov. 6, 1890, when an important improvement was made by which a much larger proportion of the organisms could be counted. Both of these sand methods are fully described in Part II. of the special report, on pages 806–811. The improved method is known as the Sedgwick-Rafter method.

It will be seen from the above statements that three methods in all have been employed in which the number of organisms observed is expressed in figures, but that these figures represent a different proportion of the whole number of organisms contained in the water. It would be desirable to indicate the proportionate number obtained by each method; but this cannot be done with accuracy, mainly on account of the great variation in the results obtained from time to time by the first two methods.

It may be said in a general way that the number of organisms observed by the original sand method is several times that observed by the cloth method; and that the number observed by the Sedgwick-Rafter method is also several times (probably from two to four times) that observed by the original sand method. The improvement in methods has resulted not only in an increase in the total number of organisms found in a given water, but also in the number of genera.

Some changes have also been made in the classification of the organisms. The plants which were in Part I. divided into three groups, as Cyanophyceæ, other Algæ and Fungi, are in this volume classified in four groups, namely: Diatomaceæ, Cyanophyceæ, Algæ and Fungi. The animals which were not divided into groups in Part I. are in this report grouped as Rhizopoda, Infusoria, Vermes, Crustacea and Porifera.

The results are published in the present volume in much greater detail than before. The names of the different genera in each group are given with the numbers of each, except when they were present only in very small numbers. It is not feasible to make a single rule regarding omissions to apply to all cases, because it is desirable to include smaller numbers of animals than of plants, and of the larger animals than of animals generally; moreover, there are exceptional cases in which it is desirable to indicate the presence of even small numbers of the more important plants or animals. Two general rules, however, have been adopted as to the results to be printed, as follows:—

1. All genera of plants to be included in which the number observed in nineteen months aggregates 9.5 per cubic centimeter or more; that is to say, more than an average of 0.5 per month.

2. All genera of animals to be included in which the number observed in nineteen months aggregates 2.5 per cubic centimeter or more.

The larger animals, such as the larger genera of Crustacea, are included even when present only in very small numbers.

Fractions are omitted from the table, the nearest whole number of organisms per cubic centimeter being given. Where the number is 0.5 or less, the fact that the organism was present is indicated by the abbreviation pr.

EXAMINATION OF WATER SUPPLIES.

Water Supply of Adams.

Chemical Examination of Water from Bassett Brook Storage Reservoir, Adams

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
5988	1890. May 15	May 17	Very slight.	None.	0.0	2.90	.0000	.0040	.10	.0350	.0000	1.9

Odor, none. —— The sample was collected from a faucet in the town.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 2; *Synedra*, pr. Algæ, *Chlorococcus*, 4; *Closterium*, pr. Total organisms, 7.

Water Supply of Andover.

Description of Works. — Population in 1890, 6,142. The works are owned by the town. Water was introduced in March, 1890. The amount of water used near the end of the year was about 150,000 gallons per day. The source of supply is Haggett's Pond in Andover, about three miles west of the village. The area of this pond is about 160 acres. Its drainage area of about 2.4 square miles is generally sandy, and contains a very small population. There are two picnic groves on the shores of the pond. Water is pumped from the pond to a distributing reservoir located south-east of and near the village. This reservoir is circular in shape, 110 feet in diameter at the bottom and 149 feet in diameter at high-water level. Its depth at high water is 13 feet and its capacity 1,290,000 gallons. The bottom of the reservoir is covered with a six-inch layer of cement concrete, and the sides are protected by granite block paving laid on a bedding of broken stone. Distributing mains are of cast iron. Service pipes are of lead.

ANDOVER.

Chemical Examination of Water from Haggett's Pond, Andover.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1888.														
3679	Dec. 7	-	-	-	-	-	-	-	-	-	-	.32	-	-	-
3680	Dec. 7	-	-	-	-	-	-	-	-	-	-	.37	-	-	-
	1889.														
4909	July 5	July 6	V. sl't.	Sl. gr'n	0.10	5.85	2.70	.0004	.0198	.0170	.0028	.29	.0040	.0001	1.1

Odor of No. 4909, distinctly vegetable; disappears on heating.——The samples were collected from the pond. No. 3679 was collected near the northerly shore, near where a small stream enters the pond; No. 3680 was collected about 200 yards farther east, along the same shore; No. 4909 was collected 500 feet from shore, opposite the proposed pumping station.

Microscopical Examination.

No. 4909. Diatomaceæ, *Melosira*, 4; *Synedra*, pr. Cyanophyceæ, *Anabœna*, 19; *Aphanocapsa*, 9; *Chroöcoccus*, 15. Algæ, *Chlorococcus*, 67. Rhizopoda, *Difflugia*, pr. Infusoria, *Ciliated infusorian*, pr. Total organisms, 115.

WATER SUPPLY OF ARLINGTON.

Chemical Examination of Water from the Storage Reservoir, Arlington.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6505	Sept. 11	Sept. 11	Dec'd.	Cons. yell'w.	0.60	6.65	2.50	.0000	.1836	.0430	.1406	.65	.0070	.0000	2.5

Odor, none; when heated, strongly grassy.——The sample was collected from the reservoir at a time when there was much complaint of the unsatisfactory quality of the water.

Microscopical Examination.

Diatomaceæ, *Melosira*, 496; *Synedra*, 10; *Tabellaria*, 24. Cyanophyceæ, *Anabœna*, 1392; *Aphanocapsa*, 812; *Cœlosphœrium*, 1208. Algæ, *Pediastrum*, 40; *Polyedrium*, 8; *Scenedesmus*, 24; *Staurastrum*, 8; *Sorastrum*, 8. Total organisms, 4030.

Chemical Examination of Water from a Faucet in Arlington.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6506	Sept. 11	Sept. 11	Dis., milky.	Very slight.	0.50	8.10	.0338	.0232	.64	.0080	.0001	4.2

Odor, faintly vegetable.——The sample was collected from a faucet in the village, 2½ miles from the filter-gallery.

Microscopical Examination.

Diatomaceæ, *Melosira*, 23; *Synedra*, 1. Cyanophyceæ, *Clathrocystis*, 4; *Cœlosphœrium*, 2. Fungi, *Crenothrix*, 3. Total organisms, 33.

ASHBURNHAM.

Chemical Examination of Water from Upper Naukeag Pond in Ashburnham.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	18	90.													
6378	Aug. 7	Aug. 7	V. sl't.	V. sl't.	0.02	1.85	0.85	.0000	.0162	.0128	.0034	.08	.0050	.0000	0.3
6379	Aug. 7	Aug. 7	V. sl't.	Slight.	0.03	3.00	2.15	.0006	.0140	.0102	.0038	.08	.0050	.0000	0.3

Odor, none. —— The samples were collected from the pond; No. 6378 about 1 foot below the surface; No. 6379 about 15 feet below the surface.

Microscopical Examination.

No. 6378. Diatomaceæ, *Asterionella*, 4; *Tabellaria*, 4. Algæ, *Chlorococcus*, 4; *Staurastrum*, pr. Infusoria, *Dinobryon*, pr.; *Peridinium*, 8; *Trachelomonas*, pr. Total organisms, 20.

No. 6379. Diatomaceæ, *Asterionella*, 2; *Tabellaria*, pr. Cyanophyceæ, *Anabæna*, pr. Algæ, *Chlorococcus*, 6; *Cœlastrum*, pr.; *Pandorina*, pr. Infusoria, *Dinobryon*, 1; *Peridinium*, pr. Vermes, *Anurea*, pr. Crustacea, *Cyclops*, pr. Total organisms, 11.

WATER SUPPLY OF ATTLEBOROUGH FIRE DISTRICT, ATTLEBOROUGH.

Chemical Examination of Water from the Well of the Attleborough Water Works.

[Parts per 100,000.]

	Date of		Appearance.				Ammonia.			Nitrogen as		
Number.	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albu-minoid.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	18	90.										
5982	May 15	May 15	Sli't, milky.	Sli't, earthy.	0.03	10.40	.0026	.0026	1.07	.1750	.0015	–
5983	May 15	May 15	Slight.	None.	0.03	12.20	.0004	.0010	1.22	.0300	.0038	–

Odor, none. —— Sample No. 5982 was collected from the large well; sample No. 5983 from a tubular well sunk in the bottom of the large well.

Microscopical Examination.

No. 5982. Fungi, *Crenothrix*, 10.
No. 5983. No organisms.

WATER SUPPLY OF AVON.

Description of Works. — Population in 1890, 1,384. The works are owned by the town. Water was introduced early in 1890 and in December of that year there were 127 water takers. The source of supply is a large well 20 feet in diameter and 22 feet in depth, located about 15 feet from Porter's Spring near the centre of the town and just south of the village. The well is lined, down to within 6 feet of the bottom, with a brick wall, 12 inches in thickness laid in cement. The lower portion is lined with a heavy rubble wall laid dry. The well is covered to exclude the light. Water is pumped from the well to an open iron tank 20 feet in diameter and 90 feet in height. Distributing mains are of cast iron. Service pipes are of wrought iron lined with cement.

WATER SUPPLY OF AYER.

Chemical Examination of Water from the Well of the Ayer Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid		Nitrates.	Nitrites.	
	1890.											
6526	Sept. 17	Sept. 18	None.	None.	0.0	5.60	.0000	.0014	.32	.0900	.0000	–
6528	Sept. 17	Sept. 18	None.	None.	0.0	5.40	.0000	.0012	–	.0600	.0000	3.1

Odor, none. —— Sample No. 6526 was collected from a faucet at the pumping station, while pumping; No. 6528 from a faucet at the store of J. R. Gray, about midway between the pumping station and the reservoir.

Microscopical Examination.

No. 6526. Fungi, *Crenothrix*, 1. Infusoria, *Peridinium*, 1. Total organisms, 2.
No. 6528. No organisms.

Chemical Examination of Water from the Distributing Reservoir of the Ayer Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6527	Sept. 17	Sept. 18	Sli't, green.	Sli't, green.	0.0	5.90	.0000	.0062	–	.0400	.0000	3.0

Odor, none. —— The sample was collected from the reservoir, which had been cleaned and re-filled Sept. 10, 1890. Previous to being cleaned, the reservoir had given trouble on account of an excessive growth of organisms.

Microscopical Examination.

Algæ, *Chlorococcus*, 2; *Scenedesmus*, 4. Infusoria, *Peridinium*, 4. Total organism 10.

BOSTON.

Water Supply of Boston.

Sudbury River Supply.— *Chemical Examination of Water from Cold Spring Brook, at Head of Reservoir No. 4, in Ashland.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4772	June 4	June 5	Slight.	Slight.	2.70	5.50	3.00	.0038	.0454	.0410	.0044	.19	.0040	.0001	1.6
4887	July 1	July 2	V. sl't.	V. sl't.	1.30	–	–	.0050	.0336	.0322	.0014	.27	.0040	.0002	–
5012	Aug. 5	Aug. 6	V. sl't.	V. sl't.	3.50	–	–	.0024	.0714	.0642	.0072	.22	.0020	.0000	–
5131	Sept. 3	Sept. 4	None.	V. sl't.	2.30	–	–	.0020	.0368	.0364	.0004	.35	.0050	.0001	–
5209	Oct. 2	Oct. 3	V. sl't.	V. sl't.	2.50	–	–	.0016	.0380	.0354	.0026	.34	.0020	.0001	–
5292	Nov. 4	Nov. 5	V. sl't.	V. sl't.	1.90	–	–	.0024	.0344	.0336	.0008	.32	.0050	.0000	–
5393	Dec. 2	Dec. 3	V. sl't.	V. sl't.	1.50	–	–	.0004	.0272	.0264	.0008	.26	.0170	.0000	–
	1890.														
5493	Jan. 2	Jan. 3	None.	V. sl't.	0.90	–	–	.0016	.0192	.0178	.0014	.27	.0220	.0000	–
5575	Feb. 3	Feb. 4	V. sl't.	Slight.	0.75	–	–	.0000	.0168	.0132	.0036	–	.0090	.0001	–
5727	Mar. 3	Mar. 4	V. sl't.	Cons.	0.75	–	–	.0000	.0200	.0180	.0020	.24	.0150	.0002	–
5827	Apr. 1	Apr. 2	V. sl't.	V. sl't.	0.70	–	–	.0006	.0184	.0156	.0028	.22	.0070	.0000	–
5924	May 1	May 2	Slight.	Slight.	1.20	–	–	.0024	.0272	.0244	.0028	.23	.0090	.0000	–
6018	June 2	June 3	V. sl't.	Slight.	1.80	5.20	2.55	.0012	.0322	.0290	.0032	.20	.0100	.0000	–
6147	July 1	July 2	Slight.	Slight.	0.90	4.20	–	.0030	.0318	.0310	.0008	.21	.0030	.0001	1.4
6341	Aug. 4	Aug. 5	V. sl't.	Slight.	0.30	5.10	3.00	.0024	.0272	.0222	.0050	.22	.0070	.0002	1.1
6453	Sept. 2	Sept. 3	Slight.	Slight.	0.35	3.95	1.25	.0002	.0234	.0178	.0056	.24	.0050	.0001	1.7
6549	Oct. 1	Oct. 2	Slight.	Slight.	0.50	3.80	1.45	.0000	.0200	.0146	.0054	.25	.0050	.0001	1.4
6672	Nov. 4	Nov. 5	None.	V. sl't.	1.60	4.80	2.05	.0004	.0294	.0266	.0028	.30	.0060	.0001	1.7
6771	Dec. 1	Dec. 2	V. sl't.	V. sl't.	1.20	4.05	1.75	.0010	.0264	.0214	.0050	.29	.0100	.0001	1.7
Av.	....	....	....	....	1.40	4.48	2.01	.0016	.0305	.0274	.0031	.26	.0077	.0001	1.5

Odor, distinctly vegetable, sometimes faintly vegetable, occasionally none.——The samples were collected from Cold Spring Brook, at head of Reservoir No. 4, at a depth of one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	-	2	6	6	3	-	3	4	4	4
Number of sample,	4772	4887	5012	5131	5209	5292	5393	5493	5575	5727
PLANTS.										
Diatomaceæ,	-	3	0	pr.	4	-	8	3	3	5
Ceratoneis,	-	0	0	0	0	-	0	0	1	2
Melosira,	-	0	0	0	0	-	8	0	0	0
Navicula,	-	0	0	pr.	0	-	0	pr.	0	pr.
Nitzchia,	-	0	0	0	0	-	0	0	0	0
Synedra,	-	2	0	0	4	-	pr.	3	1	3
Tabellaria,	-	1	0	0	0	-	0	0	1	0
Algæ (several genera),	-	0	0	pr.	2	-	0	1	pr.	1
Fungi. Crenothrix,	-	0	20	11	7	-	0	0	2	0
ANIMALS.										
Rhizopoda. Actinophrys,	-	0	0	0	0	-	0	0	0	0
Infusoria,	-	0	0	0	0	-	0	0	0	0
Peridinium,	-	0	0	0	0	-	0	0	0	0
Trachelomonas,	-	0	0	0	0	-	0	0	0	0
TOTAL ORGANISMS,	-	3	20	11	13	-	8	4	5	6

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	5	3	2	5	3
Number of sample,	5827	5924	6018	6147	6341	6453	6549	6672	6771
PLANTS.									
Diatomaceæ,	8	31	41	7	16	6	3	7	76
Ceratoneis,	0	5	6	1	1	0	0	0	0
Melosira,	0	0	0	0	0	4	0	0	17
Navicula,	pr.	0	1	1	1	2	1	pr.	4
Nitzchia,	0	0	2	0	0	0	0	3	30
Synedra,	6	25	23	4	11	0	1	3	25
Tabellaria,	2	1	9	1	3	0	1	1	pr.
Algæ (several genera),	1	1	2	6	2	9	3	pr.	0
Fungi. Crenothrix,	pr.	2	33	47	113	0	0	0	0
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	28	0	0	pr.
Infusoria,	1	0	pr.	pr.	1	4	0	0	0
Peridinium,	1	0	pr.	pr.	1	0	0	0	0
Trachelomonas,	0	0	0	0	0	4	0	0	0
TOTAL ORGANISMS,	10	34	76	60	132	47	6	7	76

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, in Ashland, collected one foot beneath the surface.*

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4775	June 4	June 5	Dist't.	V. sl't.	0.80	–	–	.0014	.0254	.0218	.0036	.18	.0020	.0002	–
4888	July 1	July 2	Slight.	V. sl't.	0.80	–	–	.0006	.0298	.0226	.0072	–	.0050	.0002	–
5013	Aug. 5	Aug. 6	Slight.	V. sl't.	0.60	–	–	.0022	.0234	.0202	.0032	–	.0040	.0001	–
5132	Sept. 3	Sept. 4	V. sl't.	V. sl't.	0.80	–	–	.0018	.0274	.0256	.0018	–	.0030	.0000	–
5210	Oct. 2	Oct. 3	Slight.	V. sl't.	1.20	–	–	.0026	.0248	.0230	.0018	–	.0040	.0001	–
5293	Nov. 4	Nov. 5	Slight.	Slight.	1.00	–	–	.0042	.0254	.0236	.0018	–	.0050	.0001	–
5394	Dec. 2	Dec. 3	V. sl't.	V. sl't.	1.30	–	–	.0024	.0270	.0244	.0026	–	.0140	.0002	–
	1890.														
5494	Jau. 2	Jan. 3	V. sl't.	V. sl't.	0.80	–	–	.0022	.0228	.0226	.0002	–	.0180	.0002	–
5576	Feb. 3	Feb. 4	V. sl't.	V. sl't.	0.75	–	–	.0002	.0196	.0186	.0010	–	.0070	.0001	–
5728	Mar. 3	Mar. 4	V. sl't.	Slight.	0.75	–	–	.0008	.0222	.0186	.0036	.25	.0180	.0001	–
5828	Apr. 1	Apr. 2	Slight.	V. sl't.	0.70	–	–	.0000	.0214	.0182	.0032	.21	.0090	.0000	–
5925	May 1	May 2	Slight.	Slight.	0.70	–	–	.0024	.0202	.0182	.0020	.24	.0090	.0001	–
6019	June 2	Juue 3	V. sl't.	V. sl't.	0.50	3.50	1.15	.0002	.0186	.0176	.0010	.24	.0050	.0000	–
6148	July 1	July 2	Slight.	Slight.	0.50	3.40	–	.0008	.0248	.0200	.0048	.21	.0020	.0001	–
6342	Aug. 4	Aug. 5	Slight.	Slight.	0.35	3.40	1.10	.0000	.0278	.0194	.0084	.22	.0120	.0002	1.4
6454	Sept. 2	Sept. 3	Slight.	Slight.	0.35	3.35	1.55	.0000	.0206	.0180	.0026	.24	.0100	.0001	1.9
6550	Oct. 1	Oct. 2	Slight.	Slight.	0.40	3.55	1.50	.0000	.0204	.0150	.0054	.24	.0080	.0001	1.7
6673	Nov. 4	Nov. 5	V. sl't.	Slight.	0.85	4.00	1.45	.0012	.0256	.0230	.0026	.27	.0070	.0002	1.7
6772	Dec. 1	Dec. 2	V. sl't.	Slight.	0.70	4.20	1.65	.0012	.0222	.0198	.0024	.26	.0100	.0001	1.7
Av.	....	....	....	....	0.73	3.67	1.40	.0013	.0237	.0205	.0031	.23	.0080	.0001	1.7

Odor, generally very faintly vegetable or none; seldom disagreeable. —— The samples were collected from the reservoir, near the gate-house, at a depth of one foot beneath the surface. For mouthly record of height of water in this reservoir, see page 108.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889. June.	1889. July.	1889. Aug.	1889. Sept.	1889. Oct.	1889. Nov.	1889. Dec.	1890. Jan.	1890. Feb.	1890. Mar.
Day of examination,	–	2	6	6	3	–	3	4	4	4
Number of sample,	–	4888	5013	5132	5210	–	5394	5494	5576	5728
PLANTS.										
Diatomaceæ,	**–**	**0**	**0**	**0**	**pr.**	**–**	**2**	**7**	**0**	**4**
Cyclotella,	–	0	0	0	0	–	0	0	0	pr.
Melosira,	–	0	0	0	0	–	0	1	0	0
Stephanodiscus,	–	0	0	0	pr.	–	0	pr.	0	0
Synedra,	–	0	0	0	0	–	0	4	0	4
Tabellaria,	–	0	0	0	0	–	2	2	0	0
Cyanophyceæ,	**–**	**0**	**0**	**0**	**0**	**–**	**0**	**0**	**0**	**6**
Aphanocapsa,	–	0	0	0	0	–	0	0	0	6
Chroöcoccus,	–	0	0	0	0	–	0	0	0	0
Algæ,	**–**	**0**	**23**	**62**	**97**	**–**	**21**	**24**	**2**	**5**
Chlorococcus,	–	0	23	62	97	–	0	6	0	3
Closterium,	–	0	0	0	0	–	21	18	2	2
Conferva,	–	0	0	0	0	–	0	0	0	0
Raphidium,	–	0	0	0	0	–	0	0	0	0
Staurogenia,	–	0	0	0	0	–	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
ANIMALS.										
Rhizopoda. Actinophrys,	–	0	0	0	0	–	0	0	0	0
Infusoria. Dinobryon,	–	0	0	pr.	1	–	pr.	0	0	0
Vermes (several genera),	–	0	2	pr.	pr.	–	0	pr.	0	0
Porifera. Sponge spicules,	–	0	0	0	0	–	0	0	0	0
TOTAL ORGANISMS,	–	0	25	62	98	–	23	31	2	15

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	6	3	2	5	3
Number of sample,	5828	5925	6019	6148	6342	6454	6550	6673	6772
PLANTS.									
Diatomaceæ,	7	16	107	19	42	1	1	3	62
Cyclotella,	0	0	92	14	42	0	0	0	0
Melosira,	0	0	8	3	0	0	0	0	0
Stephanodiscus,	0	5	0	0	0	0	0	3	25
Synedra,	5	9	5	2	pr.	1	1	pr.	36
Tabellaria,	2	2	2	0	0	0	0	pr.	1
Cyanophyceæ,	4	0	0	0	0	0	1	0	28
Aphanocapsa,	4	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	1	0	28
Algæ,	2	114	108	1	2	28	9	11	62
Chlorococcus,	0	92	104	0	2	10	9	8	5
Closterium,	2	22	2	1	0	0	0	0	pr.
Conferva,	0	0	0	0	0	18	0	0	0
Raphidium,	0	0	2	0	0	0	0	3	46
Staurogenia,	0	0	0	0	0	0	0	0	11
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	14	0	0	0
Infusoria. Dinobryon,	0	2	pr.	0	0	0	0	0	1
Vermes (several genera),	0	pr.	0	0	0	0	0	0	pr.
Porifera. Sponge spicules,	0	0	0	0	0	1	0	0	0
TOTAL ORGANISMS,	13	132	215	20	44	44	11	14	153

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, in Ashland, collected twenty feet beneath the surface.*

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4773	June 4	June 5	Slight.	Slight.	0.70	–	–	.0026	.0260	.0218	.0042	.20	.0020	.0002	–
4889	July 1	July 2	V. sl't.	V. sl't.	0.70	–	–	.0058	.0224	.0188	.0036	–	.0060	.0002	–
5014	Aug. 5	Aug. 6	V. sl't.	V. sl't.	0.70	–	–	.0054	.0294	.0272	.0022	–	.0020	.0001	–
5133	Sept. 3	Sept. 4	V. sl't.	V. sl't.	1.20	–	–	.0038	.0312	.0258	.0054	–	.0040	.0001	–
5211	Oct. 2	Oct. 3	Slight.	Slight.	0.90	–	–	.0024	.0262	.0230	.0032	–	.0030	.0001	–
5294	Nov. 4	Nov. 5	V. sl't.	Slight.	1.00	–	–	.0038	.0244	.0214	.0030	–	.0040	.0001	–
5395	Dec. 2	Dec. 3	Slight.	V. sl't.	1.20	–	–	.0028	.0274	.0218	.0056	–	.0090	.0002	–
	1890.														
5495	Jan. 2	Jan. 3	V. sl't.	V. sl't.	0.80	–	–	.0036	.0228	.0212	.0016	–	.0200	.0000	–
5577	Feb. 3	Feb. 4	V. sl't.	V. sl't.	0.75	–	–	.0000	.0174	.0166	.0008	–	.0100	.0001	–
5729	Mar. 3	Mar. 4	V. sl't.	Slight.	0.90	–	–	.0008	.0228	.0176	.0052	.25	.0120	.0001	–
5829	Apr. 1	Apr. 2	Slight.	Slight.	0.70	–	–	.0004	.0190	.0160	.0030	.22	.0150	.0001	–
5926	May 1	May 2	Slight.	Slight.	0.75	–	–	.0026	.0176	.0130	.0046	.23	.0070	.0001	–
6020	June 2	June 3	Slight.	Slight.	0.60	3.65	1.45	.0016	.0186	.0156	.0030	.23	.0080	.0000	–
6149	July 1	July 2	Slight.	Slight.	0.50	3.20	–	.0036	.0284	.0188	.0096	.19	.0030	.0001	–
6343	Aug. 4	Aug. 5	Slight.	Slight.	0.40	3.90	2.05	.0048	.0218	.0188	.0030	.20	.0150	.0003	1.4
6455	Sept. 2	Sept. 3	Slight.	Slight.	0.40	4.45	1.75	.0000	.0216	.0176	.0040	.26	.0150	.0001	1.8
6551	Oct. 1	Oct. 2	Slight.	Slight.	0.45	3.30	1.05	.0002	.0196	.0154	.0042	.24	.0080	.0001	1.7
6674	Nov. 4	Nov. 5	V. sl't.	Slight.	0.85	3.90	1.65	.0000	.0222	.0172	.0050	.26	.0080	.0002	1.6
6773	Dec. 1	Dec. 2	V. sl't.	Slight.	0.70	4.00	1.70	.0018	.0238	.0202	.0036	.25	.0100	.0001	1.6
Av.	....	....	....	....	0.75	3.87	1.61	.0024	.0233	.0194	.0039	.23	.0085	.0001	1.6

Odor, very faintly vegetable or none. —— The samples were collected from the reservoir, near the gate-house, at a depth of 20 feet beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination, ...	–	2	6	6	3	–	3	4	4	4
Number of sample, ...	–	4889	5014	5133	5211	–	5395	5495	5577	5729
PLANTS.										
Diatomaceæ, ...	–	pr.	0	0	11	–	0	6	0	pr.
Cyclotella, ...	–	0	0	0	0	–	0	0	0	0
Melosira, ...	–	0	0	0	9	–	0	0	0	0
Stephanodiscus, ...	–	0	0	0	0	–	0	0	0	0
Synedra, ...	–	pr.	0	0	2	–	0	2	0	pr.
Tabellaria, ...	–	0	0	0	0	–	0	4	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
PLANTS — Con.										
Cyanophyceæ. Chroöcoccus,	–	0	0	0	0	–	0	0	0	0
Algæ,	–	0	8	95	142	–	28	19	3	0
Chlorococcus,	–	0	8	95	140	–	3	pr.	0	0
Closterium,	–	0	0	0	2	–	25	19	3	0
Raphidium,	–	0	0	pr.	pr.	–	0	0	0	0
Staurogenia,	–	0	0	0	0	–	0	0	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	–	0	0	0	0	–	0	0	0	0
Infusoria,	–	0	0	0	6	–	0	pr.	0	0
Dinobryon,	–	0	0	0	0	–	0	pr.	0	0
Vorticella,	–	0	0	0	6	–	0	0	0	0
TOTAL ORGANISMS,	–	0	8	95	159	–	28	25	3	0

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	6	3	2	5	3
Number of sample,	5829	5926	6020	6149	6343	6455	6551	6674	6773
PLANTS.									
Diatomaceæ,	5	28	119	252	27	0	1	1	72
Cyclotella,	0	0	104	250	27	0	0	0	0
Melosira,	0	12	11	0	0	0	0	0	1
Stephanodiscus,	0	5	0	pr.	0	0	0	0	41
Synedra,	5	7	2	2	0	0	1	1	30
Tabellaria,	0	4	2	0	0	0	0	0	pr.
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	0	0	0	26
Algæ,	4	27	10	26	pr.	0	5	5	97
Chlorococcus,	0	21	8	26	pr.	0	3	5	6
Closterium,	4	6	2	0	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	2	0	66
Staurogenia,	0	0	0	0	0	0	0	0	25
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	7	0	0	pr.
Infusoria,	0	17	0	6	0	1	0	0	pr.
Dinobryon,	0	17	0	6	0	1	0	0	pr.
Vorticella,	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	9	72	129	284	27	8	6	6	195

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 4, in Ashland, collected near the bottom.*

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4774	June 4	June 5	V. sl't.	V. sl't.	0.60	–	–	.0038	.0206	.0182	.0024	.22	.0050	.0002	–
4890	July 1	July 2	Dist't.	V. sl't.	1.00	–	–	.0058	.0230	.0206	.0024	–	.0050	.0002	–
5015	Aug. 5	Aug. 6	Slight.	V. sl't.	0.60	–	–	.0030	.0208	.0204	.0004	–	.0080	.0001	–
5134	Sept. 3	Sept. 4	Slight, milky.	V. sl't.	0.70	–	–	.0018	.0196	.0180	.0016	–	.0080	.0001	–
5212	Oct. 2	Oct. 3	Slight.	V. sl't.	1.00	–	–	.0016	.0214	.0192	.0022	–	.0050	.0000	–
5295	Nov. 4	Nov. 5	V. sl't.	Slight.	1.10	–	–	.0034	.0242	.0212	.0030	–	.0040	.0001	–
5396	Dec. 2	Dec. 3	V. sl't.	Slight.	1.10	–	–	.0032	.0278	.0236	.0042	–	.0180	.0002	–
	1890.														
5496	Jan. 2	Jan. 3	V. sl't.	V. sl't.	0.80	–	–	.0022	.0230	.0214	.0016	–	.0200	.0000	–
5578	Feb. 3	Feb. 4	V. sl't.	V. sl't.	0.75	–	–	.0000	.0182	.0162	.0020	–	.0120	.0002	–
5730	Mar. 3	Mar. 4	Slight.	Cons.	0.90	–	–	.0010	.0212	.0176	.0036	.23	.0150	.0002	–
5830	Apr. 1	Apr. 2	Slight.	Slight, fibr'us.	0.70	–	–	.0004	.0208	.0156	.0052	.23	.0090	.0001	–
5927	May 1	May 2	Slight.	Slight.	0.70	–	–	.0026	.0178	.0154	.0024	.24	.0070	.0001	–
6021	June 2	June 3	Slight.	Slight.	0.70	3.80	1.25	.0024	.0160	.0142	.0018	.25	.0080	.0001	–
6150	July 1	July 2	Slight.	V. sl't.	0.40	3.20	–	.0050	.0168	.0156	.0012	.20	.0075	.0002	–
6344	Aug. 4	Aug. 5	V. sl't.	Slight, fibr'us.	0.35	4.00	1.85	.0014	.0200	.0166	.0034	.17	.0150	.0003	1.3
6456	Sept. 2	Sept. 3	Slight.	Cons.	0.50	3.95	1.65	.0008	.0220	.0168	.0052	.26	.0150	.0001	1.8
6552	Oct. 1	Oct. 2	Slight.	Cons.	0.55	3.80	1.50	.0024	.0170	.0124	.0046	.24	.0150	.0002	1.7
6675	Nov. 4	Nov. 5	V. sl't.	Slight, fibr'us.	0.85	4.05	1.50	.0002	.0226	.0198	.0028	.25	.0080	.0002	1.7
6774	Dec. 1	Dec. 2	V. sl't.	Slight.	0.70	4.20	1.50	.0016	.0234	.0198	.0036	.27	.0120	.0001	1.6
Av.	....	....	....	....	0.74	3.97	1.54	.0022	.0209	.0180	.0029	.23	.0103	.0001	1.6

Odor, very faintly vegetable or none. —— The samples were collected from the reservoir, near the bottom, just above the gate-house. When the reservoir is full the sample is collected 40 feet beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	–	2	6	7	3	–	3	4	4	5
Number of sample,	–	4890	5015	5134	5212	–	5396	5496	5578	5730
PLANTS.										
Diatomaceæ,	–	**0**	**0**	**0**	**0**	–	**pr.**	**2**	**1**	**58**
Cyclotella,	–	0	0	0	0	–	0	0	0	0
Melosira,	–	0	0	0	0	–	0	0	0	0
Stephanodiscus,	–	0	0	0	0	–	0	1	0	0
Synedra,	–	0	0	0	0	–	pr.	1	1	58
Cyanophyceæ,	–	**0**	**0**	**0**	**0**	–	**0**	**0**	**0**	**0**
Chroöcoccus,	–	0	0	0	0	–	0	0	0	0
Microcystis,	–	0	0	0	0	–	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
PLANTS — Con.										
Algæ,	–	0	12	39	44	–	17	27	3	0
Chlorococcus,	–	0	12	39	44	–	0	0	0	0
Closterium,	–	0	0	0	0	–	17	27	3	0
Staurogenia,	–	0	0	0	0	–	0	0	0	0
Fungi. Crenothrix,	–	0	1	12	pr.	–	pr.	0	0	pr.
ANIMALS.										
Rhizopoda. Actinophrys,	–	0	0	0	0	–	0	0	0	0
Infusoria,	–	0	0	0	1	–	0	0	0	0
Dinobryon,	–	0	0	0	0	–	0	0	0	0
Monas,	–	0	0	0	1	–	0	0	0	0
TOTAL ORGANISMS,	–	0	13	51	45	–	17	29	4	58

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	6	3	2	5	3
Number of sample,	5830	5927	6021	6150	6344	6456	6552	6675	6774
PLANTS.									
Diatomaceæ,	3	11	22	27	22	2	0	3	88
Cyclotella,	0	0	15	26	12	0	0	0	0
Melosira,	0	0	3	0	9	0	0	0	0
Stephanodiscus,	0	4	0	0	1	0	0	3	58
Synedra,	3	7	4	1	pr.	2	0	pr.	30
Cyanophyceæ,	0	0	0	0	0	0	0	pr.	29
Chroöcoccus,	0	0	0	0	0	0	0	0	19
Microcystis,	0	0	0	0	0	0	0	pr.	10
Algæ,	1	21	10	0	0	0	0	12	50
Chlorococcus,	0	14	7	0	0	0	0	12	2
Closterium,	1	9	3	0	0	0	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	48
Fungi. Crenothrix,	0	pr.	0	1	0	3	6	0	0
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	14	0	0	0
Infusoria,	1	9	0	0	0	1	0	0	0
Dinobryon,	0	9	0	0	0	0	0	0	0
Monas,	1	0	0	0	0	1	0	0	0
TOTAL ORGANISMS,	5	41	32	28	22	20	6	15	167

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Sudbury River at Upper End of Reservoir No. 2, in Ashland.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4777	June 4	June 5	Slight.	Slight.	1.50	–	–	.0028	.0316	.0292	.0024	.23	.0050	.0003	–
4891	July 1	July 2	V. sl't.	V. sl't.	1.30	–	–	.0016	.0336	.0314	.0022	–	.0040	.0003	–
5016	Aug. 5	Aug. 6	Slight.	Cons., rusty.	2.80	–	–	.0042	.0544	.0526	.0018	.27	.0040	.0001	–
5135	Sept. 3	Sept. 4	V. sl't.	Slight.	1.50	–	–	.0026	.0340	.0304	.0036	.37	.0070	.0001	–
5213	Oct. 2	Oct. 3	V. sl't.	Slight.	1.50	–	–	.0000	.0312	.0294	.0018	.39	.0040	.0000	–
5296	Nov. 4	Nov. 5	Slight.	Cons.	1.30	–	–	.0006	.0326	.0258	.0068	.40	.0050	.0001	–
5397	Dec. 2	Dec. 3	V. sl't.	Slight.	1.10	–	–	.0010	.0254	.0224	.0030	.30	.0150	.0001	–
	1890.														
5484	Jan. 2	Jan. 3	Slight.	Cous.	0.50	–	–	.0006	.0214	.0184	.0030	.32	.0120	.0000	–
5579	Feb. 3	Feb. 4	Slight.	Slight.	0.75	–	–	.0000	.0158	.0148	.0010	.32	.0120	.0002	–
5731	Mar. 3	Mar. 4	V. sl't.	Slight.	0.55	–	–	.0002	.0158	.0136	.0022	.27	.0150	.0001	–
5831	Apr. 1	Apr. 2	V. sl't.	V. sl't.	0.55	–	–	.0000	.0166	.0118	.0048	.25	.0100	.0002	–
5928	May 1	May 2	V. sl't.	Cons.	1.00	–	–	.0020	.0234	.0214	.0020	.28	.0040	.0001	–
6022	June 2	June 3	V. sl't.	Slight.	1.10	4.70	1.75	.0022	.0308	.0260	.0048	.24	.0100	.0000	–
6151	July 1	July 2	Dist't.	Slight.	0.70	5.10	–	.0034	.0390	.0312	.0078	.24	.0055	.0002	1.6
6345	Aug. 4	Aug. 5	Slight.	Cons.	0.70	5.20	2.45	.0042	.0334	.0310	.0024	.32	.0140	.0003	1.6
6457	Sept. 2	Sept. 3	Slight.	Cons.	0.70	4.85	1.80	.0014	.0300	.0258	.0042	.28	.0150	.0001	1.7
6553	Oct. 1	Oct. 2	V. sl't.	Slight.	1.40	6.95	2.60	.0010	.0322	.0282	.0040	.41	.0250	.0002	1.8
6676	Nov. 3	Nov. 4	V. sl't.	Cons.	1.10	4.60	2.15	.0012	.0244	.0194	.0050	.34	.0100	.0002	1.7
6763	Dec. 1	Dec. 2	Slight.	Slight.	0.80	4.75	1.80	.0006	.0244	.0226	.0018	.34	.0300	.0001	1.8
Av.	………	………	………	………	1.10	5.17	2.09	.0016	.0289	.0255	.0034	.31	.0109	.0001	1.7

Odor, generally faintly vegetable. —— The samples were collected from the river, near the old dam at the upper end of Reservoir No. 2, at a depth of one foot beneath the surface.

BOSTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	2	6	7	3	-	3	4	4	5
Number of sample,	4777	4891	5016	5135	5213	-	5397	5484	5579	5731
PLANTS.										
Diatomaceæ,	6	4	3	pr.	1	-	9	9	6	10
Cyclotella,	0	0	0	0	0	-	0	0	0	0
Melosira,	pr.	0	0	0	0	-	2	0	0	0
Meridion,	0	0	0	0	0	-	0	pr.	1	2
Navicula,	0	0	1	pr.	1	-	0	0	2	2
Nitzchia,	0	0	0	0	pr.	-	0	0	0	0
Synedra,	4	4	pr.	0	0	-	4	9	3	6
Tabellaria,	2	0	2	0	pr.	-	3	-	-	pr.
Algæ. Chlorococcus,	0	0	0	1	pr.	-	0	0	0	0
Fungi. Crenothrix,	1	0	2	47	30	-	1	10	0	1
ANIMALS.										
Infusoria,	pr.	0	0	pr.	0	-	0	pr.	0	1
Monas,	pr.	0	0	0	0	-	0	pr.	0	0
Peridinium,	0	0	0	0	0	-	0	0	0	1
Trachelomonas,	0	0	0	pr.	0	-	0	0	0	pr.
Porifera. Sponge spicules,	0	0	0	0	0	-	0	0	0	0
TOTAL ORGANISMS,	7	4	5	48	31	-	10	19	6	12

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	6	3	2	5	2
Number of sample,	5831	5928	6022	6151	6345	6457	6553	6676	6763
PLANTS.									
Diatomaceæ,	25	56	39	6	19	4	9	13	66
Cyclotella,	0	0	6	6	0	0	0	0	0
Melosira,	0	0	1	0	10	0	8	4	3
Meridion,	6	0	pr.	0	0	0	0	0	6
Navicula,	2	1	4	0	3	2	1	2	3
Nitzchia,	0	0	0	0	0	0	0	0	33
Synedra,	13	35	17	0	5	2	0	3	15
Tabellaria,	4	20	11	0	1	0	0	4	6
Algæ. Chlorococcus,	1	2	7	2	13	0	0	0	0
Fungi. Crenothrix,	pr.	6	59	196	4	22	18	3	1
ANIMALS.									
Infusoria,	1	0	3	2	2	0	0	0	pr.
Monas,	0	0	3	0	0	0	0	0	0
Peridinium,	1	0	0	2	0	0	0	0	0
Trachelomonas,	0	0	0	0	2	0	0	0	pr.
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	3
TOTAL ORGANISMS,	27	64	108	206	38	26	27	16	70

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 2, in Framingham.*

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4776	June 4	June 5	Dist't.	Slight.	1.30	–	–	.0010	.0358	.0270	.0088	.23	.0040	.0002	–
4892	July 1	July 2	Dist't.	Slight.	1.30	–	–	.0002	.0402	.0300	.0102	–	.0040	.0000	–
5017	Aug. 5	Aug. 6	Slight.	Slight.	1.00	–	–	.0050	.0398	.0376	.0022	.23	.0040	.0001	–
5136	Sept. 3	Sept. 4	Slight.	V. sl't.	1.50	–	–	.0032	.0390	.0336	.0054	.34	.0040	.0001	–
5214	Oct. 2	Oct. 3	Slight.	Slight.	1.40	–	–	.0030	.0324	.0308	.0016	.39	.0040	.0001	–
5297	Nov. 4	Nov. 5	Slight.	V. sl't.	1.20	–	–	.0018	.0288	.0248	.0040	.38	.0070	.0001	–
5398	Dec. 2	Dec. 3	Slight.	Slight.	1.10	–	–	.0008	.0238	.0216	.0022	.25	.0100	.0001	–
	1890.														
5485	Jan. 2	Jan. 3	Slight.	Slight.	0.60	–	–	.0002	.0180	.0168	.0012	.29	.0120	.0000	–
5580	Feb. 3	Feb. 4	Slight.	Slight.	0.70	–	–	.0000	.0162	.0124	.0038	.30	.0120	.0001	–
5732	Mar. 3	Mar. 4	Slight.	V. sl't.	0.55	–	–	.0000	.0208	.0168	.0040	.28	.0150	.0001	–
5832	Apr. 1	Apr. 2	V. sl't.	V. sl't.	0.60	–	–	.0000	.0154	.0128	.0026	.24	.0100	.0001	–
5929	May 1	May 2	Slight.	Slight.	0.70	–	–	.0016	.0208	.0184	.0024	.27	.0060	.0000	–
6023	June 2	June 3	V. sl't.	Slight.	1.20	4.60	2.30	.0006	.0240	.0214	.0026	.25	.0110	.0001	–
6152	July 1	July 2	Slight.	Slight.	0.70	4.35	–	.0026	.0308	.0270	.0038	.21	.0020	.0002	1.5
6346	Aug. 4	Aug. 5	Dist't.	Cons.	0.80	3.95	1.20	.0000	.0330	.0212	.0118	.26	.0090	.0002	1.6
6458	Sept. 2	Sept. 3	Dist't.	Cons.	0.50	4.00	1.95	.0002	.0286	.0210	.0076	.28	.0080	.0001	1.8
6554	Oct. 1	Oct. 2	Slight.	Cons.	0.75	5.30	1.85	.0012	.0278	.0226	.0052	.32	.0100	.0001	1.8
6677	Nov. 3	Nov. 4	V. sl't.	Cons.	1.20	4.75	1.90	.0024	.0260	.0198	.0062	.33	.0100	.0002	1.7
6764	Dec. 1	Dec. 2	Slight.	Slight.	0.90	4.85	1.80	.0026	.0206	.0192	.0014	.33	.0480	.0001	1.7
Av.	....	....	....	....	0.95	4.57	1.83	.0014	.0275	.0229	.0046	.29	.0100	.0001	1.7

Odor, generally faintly vegetable, occasionally none. No. 6346 was strongly vegetable and grassy. —— The samples were collected from the reservoir near the gate-house at a depth of 8 feet beneath the surface. For monthly record of heights of water in this reservoir, see page 108.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination, ...	10	2	6	7	3	–	3	4	4	5
Number of sample, ...	4776	4892	5017	5136	5214	–	5398	5485	5580	5732
PLANTS.										
Diatomaceæ, ...	**20**	**14**	**7**	**7**	**3**	–	**1**	**7**	pr.	**4**
Cyclotella, ...	0	0	0	0	0	–	0	0	0	0
Melosira, ...	3	0	0	0	pr.	–	0	2	0	0
Navicula, ...	0	0	0	0	pr.	–	pr.	0	0	0
Raphidium, ...	pr.	0	0	0	0	–	0	0	0	0
Synedra, ...	15	7	3	7	2	–	1	5	pr.	4
Tabellaria, ...	2	7	4	0	1	–	0	0	0	0
Cyanophyceæ. Chroöcoccus, .	**0**	**0**	**0**	**0**	**0**	–	**0**	**0**	**0**	**0**

Microscopical Examintion — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
PLANTS — Con.										
Algæ,	13	16	7	0	36	–	5	2	0	2
Chlorococcus,	13	16	7	0	36	–	0	pr.	0	1
Closterium,	0	0	0	0	pr.	–	5	2	0	1
Fungi. Crenothrix,	0	0	2	pr.	2	–	pr.	2	0	2
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	2	0	–	0	0	0	0
Infusoria,	pr.	0	pr.	1	0	–	0	9	pr.	19
Dinobryon,	pr.	0	0	0	0	–	0	8	pr.	17
Peridinium,	pr.	0	pr.	1	0	–	0	1	pr.	2
TOTAL ORGANISMS,	33	30	16	10	41	–	6	20	0	27

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	2	4	2	6	3	2	4	2
Number of sample,	5832	5929	6023	6152	6346	6458	6554	6677	6764
PLANTS.									
Diatomaceæ,	2	34	34	52	149	49	61	2	34
Cyclotella,	0	0	pr.	44	54	0	0	0	0
Melosira,	0	2	3	0	45	0	8	0	3
Navicula,	pr.	0	1	0	pr.	3	1	0	6
Raphidium,	0	0	0	0	35	6	0	0	0
Synedra,	2	29	19	8	15	40	52	2	20
Tabellaria,	0	3	11	0	0	0	0	0	5
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	18	41	0	0
Algæ,	4	13	5	13	113	40	15	0	0
Chlorococcus,	1	9	3	13	111	37	11	0	0
Closterium,	3	4	2	0	2	3	4	0	0
Fungi. Crenothrix,	2	11	6	0	1	2	2	0	3
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	2	0	0	0
Infusoria,	10	3	8	0	0	0	0	0	4
Dinobryon,	8	0	8	0	0	0	0	0	4
Peridinium,	2	3	0	0	0	0	0	0	0
TOTAL ORGANISMS,	18	61	53	65	263	111	119	2	41

BOSTON.

SUDBURY RIVER SUPPLY — *Chemical Examination of Water from Stony Brook, at Upper End of Reservoir No. 3, in Southborough.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4778	June 4	June 5	Slight.	Slight.	1.60	–	–	.0052	.0432	.0402	.0030	.37	.0180	.0005	–
4893	July 1	July 2	Slight.	Cons.	1.00	–	–	.0038	.0336	.0326	.0010	–	.0200	.0003	–
5018	Aug. 5	Aug. 6	V. sl't.	Cons.	2.00	–	–	.0054	.0604	.0538	.0066	.42	.0200	.0002	–
5137	Sept. 3	Sept. 4	V. sl't	Slight.	0.80	–	–	.0054	.0242	.0232	.0010	.82	.0180	.0002	–
5215	Oct. 2	Oct. 3	V. sl't.	Slight.	1.50	–	–	.0026	.0314	.0294	.0020	.63	.0180	.0001	–
5298	Nov. 4	Nov. 5	Slight.	V. sl't.	1.40	–	–	.0028	.0294	.0258	.0036	.61	.0210	.0002	–
5399	Dec. 2	Dec. 3	V. sl't.	V. sl't.	1.20	–	–	.0026	.0268	.0234	.0034	.43	.0400	.0002	–
	1890.														
5486	Jan. 2	Jan. 3	V. sl't.	Slight.	0.50	–	–	.0012	.0154	.0144	.0010	.49	.0350	.0005	–
5581	Feb. 3	Feb. 4	Dist't, milky.	V. sl't	0.50	–	–	.0106	.0144	.0116	.0028	.51	.0380	.0006	–
5733	Mar. 3	Mar. 4	Dist't, milky.	V. sl't.	0.60	–	–	.0028	.0196	.0156	.0040	.40	.0300	.0004	–
5833	Apr. 1	Apr. 2	V. sl't.	V. sl't.	0.55	–	–	.0000	.0150	.0132	.0018	.37	.0350	.0002	–
5930	May 1	May 2	Slight.	Slight.	0.90	–	–	.0018	.0256	.0226	.0030	.36	.0150	.0001	–
6024	June 2	June 3	V. sl't.	Cons.	1.20	6.05	2.60	.0032	.0310	.0264	.0046	.31	.0200	.0002	–
6153	July 1	July 2	V. sl't.	Slight.	0.80	6.60	–	.0036	.0346	.0330	.0016	.43	.0060	.0003	2.3
6347	Aug. 4	Aug. 5	Dist't.	Slight.	0.30	8.15	2.15	.0052	.0378	.0306	.0072	1.11	.0100	.0004	2.9
6459	Sept. 2	Sept. 3	Slight.	Cons.	0.55	9.20	2.05	.0026	.0344	.0298	.0046	.90	.0300	.0002	3.0
6555	Oct. 1	Oct. 2	V. sl't.	Slight.	1.00	8.40	2.90	.0032	.0336	.0308	.0028	.73	.0150	.0001	2.7
6678	Nov. 3	Nov. 4	V. sl't.	V. sl't.	0.95	5.85	1.60	.0022	.0198	.0180	.0018	.52	.0200	.0003	1.8
6766	Dec. 1	Dec. 2	Slight.	V. sl't	0.80	6.20	1.40	.0034	.0274	.0236	.0038	.56	.0600	.0005	1.9
Av.	....	....	....	....	0.96	7.31	2.12	.0036	.0293	.0262	.0031	.55	.0247	.0003	2.4

Odor, vegetable, sometimes none. —— The samples were collected from Stony Brook, about 50 feet below the first road above Reservoir No. 3, at a depth of one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	2	6	7	3	–	3	4	5	5
Number of sample,	4778	4893	5018	5137	5215	–	5399	5486	5581	5733
PLANTS.										
Diatomaceæ,	**0**	**37**	**2**	**3**	**5**	–	**0**	**15**	**9**	**9**
Diatoma,	0	0	0	0	0	–	0	0	0	0
Melosira,	0	23	0	2	2	–	0	1	0	4
Meridion,	0	0	0	0	0	–	0	2	pr.	pr.
Navicula,	0	0	0	0	2	–	0	2	1	0
Nitzchia,	0	0	0	0	0	–	0	0	0	0
Synedra,	pr.	14	2	1	0	–	pr.	10	6	3
Tabellaria,	pr.	0	0	0	1	–	pr.	pr.	2	2
Algæ. Chlorococcus,	**1**	**24**	**pr.**	**0**	**0**	–	**0**	**0**	**pr.**	**pr.**
Fungi. Crenothrix,	**0**	**11**	**14**	**7**	**22**	–	**3**	**2**	**5**	**3**
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**pr.**	**0**	**0**	**0**	–	**0**	**0**	**0**	**0**
Infusoria,	**0**	**2**	**5**	**0**	**0**	–	**0**	**pr.**	**0**	**1**
Dinobryon,	0	2	5	0	0	–	0	0	0	pr.
Monas,	0	0	0	0	0	–	0	0	0	0
Peridinium,	0	0	0	0	0	–	0	0	0	1
Trachelomonas,	0	0	0	0	0	–	0	pr.	0	0
TOTAL ORGANISMS,	1	74	21	10	27	–	3	17	9	13

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	3	4	2	6	3	2	4	2
Number of sample,	5833	5930	6024	6153	6347	6459	6555	6678	6766
PLANTS.									
Diatomaceæ,	**13**	**32**	**28**	**14**	**159**	**511**	**0**	**17**	**40**
Diatoma,	0	0	0	0	0	0	0	0	18
Melosira,	0	4	8	11	157	480	0	5	0
Meridion,	3	1	0	0	0	0	0	1	2
Navicula,	0	2	3	0	0	0	0	3	3
Nitzchia,	0	0	0	0	0	0	0	2	10
Synedra,	8	23	12	3	2	31	0	6	7
Tabellaria,	2	2	5	0	0	0	0	0	0
Algæ. Chlorococcus,	**2**	**2**	**14**	**13**	**pr.**	**0**	**0**	**33**	**0**
Fungi. Crenothrix,	**0**	**8**	**7**	**19**	**52**	**10**	**10**	**0**	**3**
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**
Infusoria,	**0**	**4**	**10**	**7**	**0**	**3**	**0**	**0**	**0**
Dinobryon,	0	4	0	5	0	0	0	0	0
Monas,	0	0	8	2	0	0	0	0	0
Peridinium,	0	0	2	0	0	1	0	0	0
Trachelomonas,	0	0	0	pr.	0	2	0	0	0
TOTAL ORGANISMS,	15	46	59	53	201	524	10	52	44

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Reservoir No. 3, in Framingham.*

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4779	June 4	June 5	Slight.	Slight.	0.90	–	–	.0024	.0340	.0278	.0062	.35	.0100	.0004	–
4894	July 1	July 2	Dist't.	Slight.	0.90	–	–	.0054	.0396	.0354	.0042	–	.0100	.0002	–
5019	Aug. 5	Aug. 6	Dist't.	Slight.	0.70	–	–	.0060	.0428	.0366	.0062	.43	.0050	.0002	–
5138	Sept. 3	Sept. 4	Slight.	Slight.	1.20	–	–	.0030	.0420	.0332	.0088	.51	.0060	.0002	–
5216	Oct. 2	Oct. 3	Slight.	Cons.	1.20	–	–	.0046	.0350	.0272	.0078	.50	.0100	.0003	–
5299	Nov. 4	Nov. 5	V. sl't.	V. sl't.	1.20	–	–	.0050	.0328	.0288	.0040	.52	.0110	.0001	–
5400	Dec. 2	Dec. 3	Dist't.	Slight.	1.20	–	–	.0038	.0258	.0210	.0048	.43	.0230	.0003	–
	1890.														
5487	Jan. 2	Jan. 3	Slight.	V. sl't.	0.60	–	–	.0012	.0184	.0176	.0008	.40	.0240	.0001	–
5582	Feb. 3	Feb. 4	Slight.	Slight.	0.50	–	–	.0014	.0128	.0114	.0014	.44	.0350	.0003	–
5734	Mar. 3	Mar. 4	Slight.	Slight.	0.55	–	–	.0020	.0186	.0154	.0032	.40	.0350	.0002	–
5834	Apr. 1	Apr. 2	Dist't.	Cons.	0.50	–	–	.0000	.0152	.0116	.0936	.32	.0300	.0002	–
5931	May 1	May 2	Slight.	Cons.	0.40	–	–	.0010	.0160	.0132	.0028	.36	.0250	.0001	–
6025	June 2	June 3	Slight.	Slight.	0.70	5.05	1.75	.0008	.0228	.0192	.0036	.35	.0200	.0001	–
6154	July 1	July 2	Slight.	Slight.	0.60	5.05	–	.0028	.0260	.0244	.0016	.35	.0100	.0004	1.8
6348	Aug. 4	Aug. 5	Dist't.	Slight.	0.50	5.30	1.80	.0030	.0358	.0268	.0090	.36	.0120	.0004	1.9
6460	Sept. 2	Sept. 3	Dist't.	Cons.	0.70	5.35	1.95	.0046	.0338	.0238	.0100	.42	.0090	.0002	2.5
6556	Oct. 1	Oct. 2	Dist't.	Cons.	0.50	5.65	1.80	.0022	.0288	.0232	.0056	.45	.0100	.0002	2.3
6679	Nov. 3	Nov. 4	V. sl't.	V sl't.	1.00	5.60	2.05	.0026	.0278	.0254	.0024	.45	.0250	.0002	1.9
6765	Dec. 1	Dec. 2	Slight.	Slight.	0.90	5.45	1.70	.0020	.0298	.0248	.0050	.46	.0400	.0002	1.9
Av.	....	....	....	....	0.78	5.40	1.84	.0028	.0283	.0235	.0048	.42	.0184	.0002	2.0

Odor, generally faintly vegetable, sometimes none. —— The samples were collected from the reservoir, near the gate-house, at a depth of 8 feet beneath the surface. For monthly record of heights of water in this reservoir see page 108.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889. June.	1889. July.	1889. Aug.	1889. Sept.	1889. Oct.	1889. Nov.	1889. Dec.	1890. Jan.	1890. Feb.	1890. Mar.
Day of examination,	10	2	6	7	3	–	4	4	5	5
Number of sample,	4779	4894	5019	5138	5216	–	5400	5487	5582	5734
PLANTS.										
Diatomaceæ,	**1**	**1**	**pr.**	**27**	**72**	–	**14**	**23**	**15**	**21**
Asterionella,	0	0	0	4	65	–	6	17	7	7
Cyclotella,	0	0	0	0	0	–	0	0	0	0
Melosira,	0	0	0	0	0	–	1	0	pr.	0
Stephanodiscus,	pr.	1	0	0	1	–	1	0	0	0
Synedra,	pr.	0	pr.	0	1	–	3	6	6	3
Tabellaria,	1	0	0	23	5	–	3	0	2	11
Cyanophyceæ,	**pr.**	**3**	**13**	**5**	**3**	–	**0**	**0**	**0**	**0**
Anabæna,	pr.	0	0	0	pr.	–	0	0	0	0
Chroöcoccus,	0	0	0	0	0	–	0	0	0	0
Clathrocystis,	0	3	13	5	3	–	0	0	0	0
Cœlosphærium,	0	0	0	0	0	–	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	Mar.
PLANTS — Con.										
Algæ,	1	107	7	2	61	–	pr.	0	4	0
Chlorococcus,	1	107	7	0	61	–	pr	0	4	0
Raphidium,	0	0	0	2	0	–	0	0	0	0
Fungi. Crenothrix,	0	0	2	0	0	–	2	2	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	0	0	–	0	0	0	0
Infusoria,	0	0	23	0	24	–	0	0	0	46
Dinobryon,	0	0	23	0	8	–	0	0	0	40
Monas,	0	0	0	0	1	–	pr.	0	0	0
Synura,	0	0	0	0	0	–	0	0	0	6
Trachelomonas,	0	0	pr.	0	10	–	0	0	0	0
Vorticella,	0	0	0	0	5	–	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	–	0	0	0	0
TOTAL ORGANISMS,	2	111	45	34	160	–	16	25	19	67

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	3	4	2	6	3	2	4	
Number of sample,	5834	5931	6025	6154	6348	6460	6556	6679	6765
PLANTS.									
Diatomaceæ,	7	361	176	324	pr.	0	32	211	734
Asterionella,	pr.	174	113	pr.	0	0	23	203	708
Cyclotella,	0	0	40	324	0	0	0	0	0
Melosira,	0	0	1	0	0	0	6	5	0
Stephanodiscus,	0	19	0	0	0	0	0	pr.	pr.
Synedra,	5	147	4	0	pr.	0	1	3	26
Tabellaria,	2	21	18	0	0	0	2	0	0
Cyanophyceæ,	0	pr.	pr.	pr.	3	451	38	0	0
Anabæna,	0	0	0	0	1	27	0	0	0
Chroöcoccus,	0	0	0	0	0	410	36	0	0
Clathrocystis,	0	pr.	pr.	pr.	2	5	2	0	0
Cœlosphærium,	0	0	0	0	0	9	0	0	0
Algæ,	0	28	90	19	155	9	0	0	0
Chlorococcus,	0	23	81	19	155	6	0	0	0
Raphidium,	0	5	9	0	0	3	0	0	0
Fungi. Crenothrix,	0	0	0	0	0	0	2	9	pr.
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	3	0	pr.	0
Infusoria,	0	11	3	1	4	2	0	0	7
Dinobryon,	0	11	0	0	0	2	0	0	6
Monas,	0	pr.	pr.	0	0	0	0	0	0
Synura,	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	pr.	0	1	4	2	0	0	1
Vorticella,	0	0	3	pr.	0	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	2	0	0	0
TOTAL ORGANISMS,	7	400	269	344	162	467	72	220	741

BOSTON.

SUDBURY RIVER SUPPLY. — *Chemical Examination of Water from Farm Pond, in Framingham.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4780	June 4	June 5	Slight.	V. sl't.	0.05	–	–	.0014	.0206	.0180	.0026	.48	.0020	.0001	–
4910	July 5	July 6	V. sl't.	Cons.	0.15	–	–	.0034	.0272	.0248	.0024	–	.0060	.0001	–
5020	Aug. 5	Aug. 6	Dist't.	Slight.	0.05	–	–	.0024	.0292	.0240	.0052	–	.0020	.0000	–
5124	Sept. 3	Sept. 4	Slight.	Slight.	0.05	–	–	.0024	.0272	.0202	.0070	–	.0020	.0000	–
5226	Oct. 4	Oct. 6	Slight, milky.	V. sl't.	0.05	–	–	.0036	.0220	.0200	.0020	.73	.0020	.0001	–
5301	Nov. 4	Nov. 5	V. sl't, milky.	V. sl't.	0.15	–	–	.0026	.0176	.0160	.0016	.73	.0030	.0001	–
5391	Dec. 2	Dec. 3	Dist't.	He'vy.	0.10	–	–	.0014	.0210	.0168	.0042	–	.0060	.0001	–
	1890.														
5488	Jan. 2	Jan. 3	Slight, milky.	Cons.	0.05	–	–	.0028	.0210	.0188	.0022	–	.0090	.0001	–
5583	Feb. 3	Feb. 4	Slight.	V. sl't	0.03	–	–	.0000	.0122	.0114	.0008	–	.0120	.0002	–
5740	Mar. 4	Mar. 5	V. sl't.	Slight.	0.05	–	–	.0000	.0208	.0180	.0028	.78	.0060	.0001	–
5835	Apr. 1	Apr. 2	Slight.	Slight.	0.10	–	–	.0002	.0228	.0214	.0014	.62	.0250	.0001	–
5933	May 1	May 2	Slight.	Cons.	0.05	–	–	.0026	.0170	.0144	.0026	.60	.0090	.0001	–
6033	June 3	June 4	Slight.	Slight.	0.10	4.65	1.10	.0018	.0174	.0160	.0014	.68	.0020	.0001	–
6155	July 1	July 2	Slight.	Slight.	0.02	5.00	–	.0020	.0166	.0158	.0008	.67	.0010	.0001	1.9
6349	Aug. 4	Aug. 5	Slight.	Slight.	0.00	5.60	1.80	.0004	.0228	.0166	.0062	.69	.0030	.0003	2.1
6461	Sept. 2	Sept. 3	Slight.	Slight.	0.00	5.00	1.25	.0032	.0274	.0244	.0030	.79	.0080	.0001	2.3
6545	Oct. 1	Oct. 2	Slight.	V. sl't.	0.00	4.95	1.10	.0004	.0166	.0118	.0048	.74	.0100	.0000	2.3
6680	Nov. 3	Nov. 4	V. sl't.	Slight, earthy.	0.05	5.05	0.95	.0058	.0164	.0132	.0032	.74	.0080	.0003	2.3
6768	Dec. 1	Dec. 2	Slight.	Slight.	0.45	6.15	2.10	.0050	.0190	.0182	.0008	.50	.0200	.0002	2.1
Av.	....	....	....	....	0.08	5.23	1.38	.0022	.0208	.0179	.0029	.67	.0072	.0001	2.2

Odor, generally faintly vegetable, sometimes none. —— The samples were collected from the pond near the pumping-station of the Framingham Water Company. For monthly record of heights of water in this pond, see page 108.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	6	6	6	8	–	3	4	5	5
Number of sample,	4780	4910	5020	5124	5226	5301	5391	5488	5583	5740
PLANTS.										
Diatomaceæ,	**1**	pr.	**0**	**0**	**1**	**8**	**10**	**47**	**0**	**77**
Asterionella,	0	0	0	0	0	0	0	3	0	60
Navicula,	0	pr.	0	0	0	4	0	1	0	0
Nitzchia,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	1	6	0	0	0	0	8	38	0	12
Synedra,	pr.	0	0	0	1	4	2	5	0	5
Cyanophyceæ,	**1**	**3**	**6**	**7**	**3**	**1**	pr.	**0**	**0**	**0**
Anabæna,	1	0	0	1	pr.	0	pr.	0	0	0
Chroöcoccus,	0	pr.	6	0	0	0	0	0	0	0
Clathrocystis,	0	pr.	6	6	2	1	0	0	0	0
Aphanocapsa,	0	2	0	0	0	0	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
PLANTS — Con.										
Algæ,	**0**	**0**	**645**	**86**	**5**	**0**	**0**	**0**	**pr.**	**0**
Chlorococcus,	0	0	645	86	5	0	0	0	pr.	0
Cœlastrum,	0	0	0	0	0	0	0	0	0	0
Protococcus,	0	pr.	0	0	9	0	0	0	–	–
ANIMALS.										
Infusoria,	**0**	**pr.**	**0**	**0**	**1**	**0**	**pr.**	**11**	**75**	**21**
Dinobryon,	0	0	0	0	1	0	0	11	24	20
Monas,	0	0	0	0	0	0	0	0	50	1
Peridinium,	0	pr.	0	0	0	0	pr.	0	1	0
Vorticella,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	2	3	651	93	10	9	10	58	75	98

	1890.								
	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	3	7	2	6	3	2	4	2
Number of sample,	5835	5933	6033	6155	6349	6461	6545	6680	6768
PLANTS.									
Diatomaceæ,	**425**	**77**	**pr.**	**1**	**2**	**4**	**0**	**2**	**136**
Asterionella,	379	7	0	0	0	0	0	0	114
Navicula,	0	0	0	0	2	2	0	2	pr.
Nitzchia,	0	0	0	0	0	0	0	0	12
Stephanodiscus,	24	58	0	0	0	0	0	0	0
Synedra,	22	12	pr.	1	pr.	2	0	pr.	10
Cyanophyceæ,	**0**	**0**	**0**	**46**	**29**	**13**	**38**	**0**	**0**
Anabæna,	0	0	0	pr.	18	0	0	0	0
Chroöcoccus,	0	0	0	0	3	12	37	0	0
Clathrocystis,	0	0	0	6	8	1	1	0	0
Aphanocapsa,	0	0	0	40	0	0	0	0	0
Algæ,	**1**	**0**	**0**	**124**	**4**	**1**	**0**	**0**	**0**
Chlorococcus,	1	0	0	112	4	1	0	0	0
Cœlastrum,	0	0	0	12	pr.	0	0	0	0
Protococcus,	0	0	0	0	0	0	0	0	0
ANIMALS.									
Infusoria,	**74**	**21**	**1**	**0**	**7**	**0**	**0**	**0**	**0**
Dinobryon,	47	21	0	0	0	0	0	0	0
Monas,	27	0	0	0	2	0	0	0	0
Peridinium,	0	0	1	0	pr.	0	0	0	0
Vorticella,	0	0	0	0	5	0	0	0	0
TOTAL ORGANISMS,	500	98	1	171	42	18	38	2	136

BOSTON.

COCHITUATE SUPPLY. — *Chemical Examination of Water from Beaver Dam Brook, in Framingham and Natick.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1889.														
4782	June 4	June 5	Dist't.	Cons.	2.30	8.25	3.70	.0096	.0510	.0442	.0068	0.24	.0150	.0010	–
	1890.														
5836	Apr. 1	Apr. 2	Slight.	Cons.	0.70	–	–	.0014	.0278	.0260	.0018	0.33	.0200	.0001	–
6381	Aug. 8	Aug. 9	V. sl't.	V. sl't.	0.20	8.37	2.80	.0018	.0168	.0146	.0022	0.77	.0125	.0001	4.3
6382	Aug. 8	Aug. 9	V. sl't.	V. sl't.	0.02	15.10	4.00	.0236	.0102	.0100	.0002	2.20	.2200	.0023	5.3
6383	Aug. 8	Aug. 9	V. sl't.	V. sl't.	0.10	12.30	2.45	.0016	.0152	.0134	.0018	2.02	.2000	.0005	4.4
6384	Aug. 8	Aug. 9	Dist't.	H'vy.	0.25	9.30	2.05	.0024	.0752	.0302	.0450	1.54	.0200	.0019	3.9
6385	Aug. 8	Aug. 9	Dist't.	Cons.	0.40	8.70	2.20	.0044	.0526	.0286	.0240	1.39	.0200	.0012	3.9

Odor of Nos. 4782 and 6383, faintly vegetable; of the remaining samples, decidedly vegetable. —— Nos. 4782 and 6383 were collected from the mouth of the brook at Mill Street, near Lake Cochituate. No. 5836 was collected from the brook south of Waverley Street, opposite the pumping-station of the Framingham sewerage system when the brook was overflowing its banks. No. 6381 was collected from the brook just above the road bridge, about 40 feet above where the stream from the underdrain of the Framingham sewerage system enters the brook. No. 6382 was collected from the brook just below the Boston & Albany Railroad, and about 300 feet below the entrance of the stream from the underdrain. No. 6384 was collected from the estuary of Beaver Dam Brook (an arm of Lake Cochituate) where it is crossed by the Boston & Albany Railroad. No. 6385 was collected from the estuary where it is crossed by the Framingham and Natick road, about 400 feet below the crossing of the Boston & Albany Railroad. For analyses of the water of the underdrain see *Framingham*.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.	1890.					
	June.	April.	Aug.	Aug	Aug.	Aug.	Aug.
Day of examination,	10	2	9	9	9	9	9
Number of sample,	4782	5836	6381	6382	6383	6384	6385
PLANTS.							
Diatomaceæ,	pr.	28	3	2	16	1,794	834
Melosira,	0	3	1	0	7	0	0
Meridion,	0	2	0	0	0	0	2
Navicula,	0	2	2	pr.	5	2	0
Stephanodiscus,	0	2	pr.	1	2	0	0
Synedra,	pr.	19	0	1	2	1,792	832
Cyanophyceæ. Anabæna,	pr.	0	0	0	0	460	328

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.	1890.					
	June.	April.	Aug.	Aug.	Aug.	Aug.	Aug.
PLANTS — Con.							
Algæ,	**1**	**0**	**0**	**0**	**2**	**2,812**	**542**
Chlorococcus,	1	0	0	0	2	0	66
Cosmarium,	0	0	0	0	0	12	0
Eudorina,	0	0	0	0	0	84	4
Gonium,	0	0	0	0	0	20	8
Pediastrum,	0	0	0	0	0	8	0
Zoöspores,	0	0	0	0	0	2,664	460
Scenedesmus,	0	0	0	0	pr.	22	2
Staurastrum,	0	0	0	0	0	2	2
Fungi. Crenothrix,	**4**	**pr.**	**31**	**28**	**13**	**0**	**0**
ANIMALS.							
Infusoria,	**0**	**3**	**0**	**0**	**pr.**	**92**	**12**
Monas,	0	2	0	0	pr.	0	0
Peridinium,	0	1	0	0	pr.	80	4
Trachelomonas,	0	0	0	0	0	0	8
Ciliated infusorian,	0	0	0	0	0	12	0
Vermes,	**0**	**0**	**0**	**0**	**0**	**24**	**42**
Anurea,	0	0	0	0	0	0	24
Asplanchna,	0	0	0	0	0	2	0
Monocerca,	0	0	0	0	0	14	2
Polyarthra,	0	0	0	0	0	4	2
Rotatorian ova,	0	0	0	0	0	2	6
Triarthra,	0	0	0	0	0	2	8
TOTAL ORGANISMS,	5	31	34	30	31	5,182	1,758

COCHITUATE SUPPLY. — *Chemical Examination of Water from Pegan Brook.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4784	June 4	June 5	Very dec'd.	He'vy, earthy.	0.3	26.05 15.00	5.80 3.60	.1200	.0760	.0400	.0360	1.79	.1620	.0040	–

Odor, musty; on heating, it became strongly musty and disagreeable. —— The sample was collected from the brook near its mouth.

Microscopical Examination.

Fungi, *Crenothrix*, 40.

BOSTON.

COCHITUATE SUPPLY. — *Chemical Examination of Water from Dudley Pond, in Wayland.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4785	June 4	June 5	Dist't.	Slight.	0.05	3.15	1.00	.0036	.0270	.0224	.0046	.24	.0030	.0000	1.3
4896	July 1	July 2	Dist't.	Slight	0.05	-	-	.0018	.0268	.0262	.0006	-	.0040	.0000	-
5022	Aug. 5	Aug. 6	Slight.	Slight.	0.05	-	-	.0010	.0308	.0220	.0088	.20	.0020	.0000	-
5140	Sept. 3	Sept. 4	Dist't.	Slight.	0.03	-	-	.0010	.0250	.0212	.0038	.26	.0050	.0000	-
Av.	....	....	....	....	0.04	-	-	.0018	.0274	.0229	.0045	.23	.0035	.0000	-

Odor, faintly vegetable; in August and September, disagreeable.—— The samples were collected from the pond near the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.			
	June.	July.	Aug.	Sept.
Day of examination,	10	2	6	7
Number of sample,	4785	4896	5022	5140
PLANTS.				
Diatomaceæ,	**9**	**15**	**43**	**38**
Asterionella,	0	0	32	21
Melosira,	0	2	3	1
Stephanodiscus,	8	2	2	0
Synedra,	1	2	pr.	6
Tabellaria,	0	9	6	10
Cyanophyceæ,	**pr.**	**pr.**	**16**	**6**
Aphanocapsa,	0	0	0	3
Chroöcoccus,	0	0	7	0
Clathrocystis,	0	pr.	pr.	3
Cœlosphærium,	pr.	0	9	0
Algæ,	**1**	**9**	**18**	**6**
Chlorococcus,	1	6	16	4
Staurastrum,	0	3	2	2
ANIMALS.				
Rhizopoda. Difflugia,	**0**	**0**	**pr.**	**pr.**
Infusoria. Dinobryon,	**20**	**1**	**4**	**0**
TOTAL ORGANISMS,	30	25	81	50

BOSTON.

COCHITUATE SUPPLY. — *Chemical Examination of Water from Lake Cochituate, in Wayland.*

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4781	June 4	June 5	Slight.	V. sl't.	0.15	–	–	.0016	.0186	.0154	.0032	.48	.0220	.0005	–
4895	July 1	July 2	Dist't.	V. sl't.	0.30	–	–	.0018	.0202	.0156	.0046	–	.0180	.0003	–
5021	Aug. 5	Aug. 6	Slight.	V. sl't.	0.10	–	–	.0018	.0184	.0172	.0012	–	.0100	.0003	–
5139	Sept. 3	Sept. 4	Slight.	Slight.	0.20	–	–	.0010	.0230	.0196	.0034	–	.0090	.0003	–
5217	Oct. 2	Oct. 3	V. sl't.	Slight.	0.30	–	–	.0012	.0212	.0180	.0032	–	.0120	.0002	–
5300	Nov. 4	Nov. 5	V. sl't.	Slight.	0.30	–	–	.0026	.0222	.0186	.0036	–	.0200	.0002	–
5401	Dec. 2	Dec. 3	V. sl't.	V. sl't.	0.40	–	–	.0078	.0222	.0186	.0036	–	.0230	.0005	–
	1890.														
5489	Jan. 2	Jan. 3	Slight.	Slight.	0.40	–	–	.0004	.0178	.0152	.0026	–	.0130	.0001	–
5584	Feb. 3	Feb. 4	Slight.	V. sl't.	0.25	–	–	.0000	.0124	.0102	.0022	–	.0250	.0002	–
5735	Mar. 3	Mar. 4	V. sl't.	Cons.	0.30	–	–	.0000	.0196	.0150	.0046	.51	.0350	.0002	–
5837	Apr. 1	Apr. 2	Slight.	Slight.	0.40	–	–	.0004	.0182	.0146	.0036	.52	.0400	.0003	–
5932	May 1	May 2	Slight.	Cons.	0.30	–	–	.0014	.0186	.0142	.0044	.49	.0280	.0001	–
6026	June 2	June 3	Slight.	Slight.	0.20	4.80	1.25	.0032	.0156	.0134	.0022	.50	.0200	.0002	–
6156	July 1	July 2	Slight.	Slight.	0.10	4.90	–	.0018	.0170	.0148	.0022	.46	.0200	.0005	2.3
6350	Aug. 4	Aug. 5	Slight.	Cons.	0.03	4.75	0.95	.0018	.0216	.0158	.0058	.48	.0120	.0007	2.1
6465	Sept. 2	Sept. 3	Slight.	Slight.	0.10	4.45	0.80	.0010	.0258	.0196	.0062	.49	.0070	.0003	2.5
6557	Oct. 1	Oct. 2	Slight.	Slight.	0.05	4.25	0.85	.0010	.0194	.0154	.0040	.48	.0150	.0002	2.3
6681	Nov. 3	Nov. 4	V. sl't.	V. sl't.	0.20	5.00	1.30	.0040	.0146	.0134	.0012	.49	.0120	.0003	2.5
6767	Dec. 1	Dec. 2	Slight.	Slight.	0.15	5.20	1.05	.0046	.0206	.0170	.0036	.49	.0200	.0002	2.5
Av.	....	....	....	....	0.22	4.74	1.03	.0020	.0193	.0158	.0035	.49	.0190	.0003	2.4

Odor, generally none; sometimes very faintly vegetable. —— The samples were collected in the gate-house. For analyses of samples from various depths in the lake, collected June 18, 1890, see special report of the State Board of Health on Water Supply and Sewerage, 1890, Part I., p. 767. For monthly record of heights of water in this lake, see page 108.

BOSTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	2	6	7	3	–	4	4	5	5
Number of sample,	4781	4895	5021	5139	5217	5300	5401	5489	5584	5735
PLANTS.										
Diatomaceæ,	**12**	**34**	**22**	**23**	**144**	**136**	**141**	**189**	**380**	**1,271**
Asterionella,	0	0	0	6	72	8	5	25	64	181
Melosira,	0	0	0	0	25	8	75	128	304	1,039
Nitzchia,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	8	2	1	0	1	6	30	18	5	16
Synedra,	0	6	0	8	7	0	16	5	pr.	4
Tabellaria,	4	26	21	9	39	114	15	13	7	31
Cyanophyceæ,	**pr.**	**22**	**54**	**31**	**14**	**pr.**	**10**	**0**	**0**	**0**
Anabæna,	pr.	8	24	8	3	0	0	0	0	0
Aphanocapsa,	0	0	0	0	0	0	10	0	0	0
Chroöcoccus,	0	8	17	0	0	0	0	0	0	0
Clathrocystis,	0	6	6	13	2	0	pr.	0	0	0
Cœlosphærium,	0	0	7	10	9	pr.	pr.	0	0	0
Microcystis,	0	0	0	0	0	0	0	0	0	0
Oscillaria,	0	0	0	0	0	0	0	0	0	0
Algæ,	**5**	**53**	**63**	**11**	**74**	**0**	**9**	**1**	**16**	**0**
Chlorococcus,	5	53	62	0	6	0	9	0	16	0
Closterium,	0	0	0	0	68	0	0	0	0	0
Cœlastrum,	0	0	1	pr.	pr.	0	0	1	0	0
Spirotænia,	0	0	0	11	0	0	0	0	0	0
Fungi. Beggiatoa,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**23**	**4**	**5**
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**pr.**	**pr.**	**1**	**7**	**0**	**5**	**2**	**2**	**22**
Ceratium,	0	pr.	0	1	pr.	0	0	0	0	0
Dinobryon,	0	0	pr.	0	6	0	pr.	0	0	0
Monas,	0	0	0	0	0	0	0	0	0	18
Peridinium,	0	0	0	0	0	0	0	0	1	1
Trachelomonas,	pr.	0	0	0	1	0	5	2	1	3
Crustacea. Cyclops,	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	17	109	139	66	239	136	165	215	402	1,298

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	3	4	2	6	3	2	4	2
Number of sample,	5837	5932	6026	6156	6350	6465	6557	6681	6767
PLANTS.									
Diatomaceæ,	**1,415**	**1,104**	**185**	**31**	**7**	**50**	**42**	**113**	**1,315**
Asterionella,	413	8	0	0	0	0	40	19	138
Melosira,	865	412	0	0	7	0	0	78	972
Nitzchia,	0	0	0	0	0	0	0	0	23
Stephanodiscus,	11	25	103	1	0	0	0	2	62
Synedra,	1	54	1	23	0	50	2	pr.	2
Tabellaria,	125	605	81	7	0	0	0	14	118

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
PLANTS — Con.									
Cyanophyceæ,	0	0	0	34	21	450	31	41	80
Anabæna,	0	0	0	16	7	5	0	34	0
Aphanocapsa,	0	0	0	4	5	0	0	pr.	1
Chroöcoccus,	0	0	0	0	0	442	27	0	0
Clathrocystis,	0	0	0	2	5	0	4	0	1
Cœlosphærium,	0	0	0	12	4	3	0	3	3
Microcystis,	0	0	0	0	0	0	0	4	9
Oscillaria,	0	0	0	0	0	0	0	0	66
Algæ,	0	2	9	331	433	0	8	0	44
Chlorococcus,	0	2	9	268	430	0	8	0	44
Closterium,	pr.	pr.	0	0	pr.	0	0	0	0
Cœlastrum,	0	0	0	63	3	0	0	0	0
Spirotænia,	0	0	0	0	0	0	0	0	0
Fungi. Beggiatoa,	0	0	0	0	0	0	0	0	0
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	0	0	4	5
Infusoria,	9	6	0	2	pr.	2	1	5	2
Ceratium,	0	0	0	2	0	0	0	0	0
Dinobryon,	4	4	0	0	0	0	1	5	2
Monas,	5	0	0	0	0	0	0	0	0
Peridinium,	0	2	0	0	pr.	0	0	0	0
Trachelomonas,	pr.	0	0	0	0	2	0	pr.	pr.
Crustacea. Cyclops,	0	0	0	0	pr.	0	0	0	pr.
TOTAL ORGANISMS,	1,424	1,112	194	398	461	502	82	163	1,446

COCHITUATE WORKS. — *Chemical Examination of Water from Chestnut Hill Distributing Reservoir.*

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4798	June 7	June 7	Slight.	Slight.	0.5	–	–	.0020	.0252	.0208	.0044	.34	.0110	.0002	–

Odor, very faintly vegetable. —— The sample was collected from the reservoir.

Microscopical Examination.

Diatomaceæ, *Stephanodiscus*, 20; *Tabellaria*, 10. Infusoria, *Dinobryon*, pr. Total organisms, 30.

BOSTON.

COCHITUATE WORKS. — *Chemical Examination of Water from Parker Hill Distributing Reservoir.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
4764	June 4	June 4	Slight.	Slight.	0.05	4.50	1.45	.0012	.0166	.0130	.0036	.45	.0180	.0004	1.9
4902	July 2	July 2	V. sl't.	V. sl't.	0.05	–	–	.0028	.0204	.0192	.0012	.42	.0070	.0003	–
5027	Aug. 6	Aug. 6	Slight.	Slight.	0.00	–	–	.0008	.0150	.0128	.0022	–	.0090	.0001	–
5128	Sept. 4	Sept. 4	V. sl't.	V. sl't.	0.03	–	–	.0000	.0172	.0148	.0024	–	.0050	.0001	–
5221	Oct. 3	Oct. 3	V. sl't.	Slight.	0.00	–	–	.0010	.0164	.0130	.0034	–	.0050	.0000	–
5304	Nov. 6	Nov. 6	V. sl't.	V. sl't.	0.70	–	–	.0006	.0242	.0230	.0012	–	.0180	.0002	–
Av.	....	....	....	....	–	–	–	.0011	.0183	.0160	.0023	.43	.0103	.0002	–

Odor, very faint or none. —— The samples were collected from the reservoir.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.					
	June.	July.	Aug.	Sept.	Oct.	Nov.
Day of examination,	–	3	6	6	3	–
Number of sample,	4764	4902	5027	5128	5221	5304
PLANTS.						
Diatomaceæ,	–	**0**	**0**	**9**	**12**	–
Melosira,	–	0	0	0	6	–
Stephanodiscus,	–	0	pr.	2	2	–
Synedra,	–	0	0	7	4	–
Cyanophyceæ,	–	**14**	**3**	**8**	**0**	–
Anabæna,	–	2	0	0	0	–
Clathrocystis,	–	pr.	3	8	0	–
Chroöcoccus,	–	12	0	0	0	–
Algæ,	–	**12**	**44**	**28**	**30**	–
Chlorococcus,	–	12	28	23	29	–
Cœlastrum,	–	0	pr.	1	1	–
Spirotænia,	–	0	16	4	0	–
ANIMALS.						
Infusoria. Dinobryon,	–	**0**	**0**	**19**	**0**	–
TOTAL ORGANISMS,	–	26	47	64	42	–

BOSTON.

COCHITUATE WORKS. — *Chemical Examination of Water from a Faucet at the Massachusetts Institute of Technology.*

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4800	June 7	June 7	Slight.	Slight.	0.45	–	–	.0002	.0208	.0172	.0036	.39	.0200	.0002	–
4899	July 2	July 2	V. sl't.	Slight.	0.70	–	–	.0010	.0226	.0186	.0040	.36	.0200	.0002	–
5037	Aug. 7	Aug. 7	V. sl't.	V. sl't.	0.30	–	–	.0010	.0194	.0154	.0040	–	.0150	.0002	–
5127	Sept. 4	Sept. 4	Slight.	Slight.	0.80	–	–	.0006	.0244	.0232	.0012	–	.0150	.0002	–
5219	Oct. 3	Oct. 3	V. sl't.	V. sl't.	0.70	–	–	.0002	.0232	.0214	.0018	–	.0150	.0002	–
5316	Nov. 7	Nov. 7	V. sl't.	Slight.	0.65	–	–	.0002	.0220	.0192	.0028	.48	.0250	.0001	–
5403	Dec. 3	Dec. 3	V. sl't.	V. sl't.	0.50	–	–	.0004	.0202	.0186	.0016	.47	.0280	.0001	–
	1890.														
5492	Jan. 3	Jan. 3	None.	V. sl't.	0.50	–	–	.0000	.0160	.0154	.0006	–	.0240	.0001	–
5587	Feb. 4	Feb. 4	V. sl't.	Slight.	0.40	–	–	.0002	.0146	.0130	.0016	–	.0320	.0001	–
5737	Mar. 4	Mar. 4	V. sl't.	Cons.	0.40	–	–	.0000	.0146	.0118	.0028	.44	.0320	.0001	–
5844	Apr. 2	Apr. 2	V. sl't.	V. sl't.	0.40	–	–	.0000	.0124	.0112	.0012	.50	.0300	.0001	–
5938	May 2	May 2	V. sl't.	V. sl't.	0.30	–	–	.0006	.0134	.0114	.0020	.45	.0300	.0000	–
6029	June 3	June 3	Slight.	Slight.	0.30	4.55	1.65	.0006	.0172	.0144	.0028	.38	.0300	.0000	–
6160	July 2	July 2	Slight.	Cons.	0.30	5.00	–	.0000	.0172	.0152	.0020	.36	.0300	.0000	2.3
6360	Aug. 5	Aug. 5	V. sl't.	Slight.	0.20	4.65	1.75	.0002	.0218	.0194	.0024	.36	.0140	.0002	2.3
6464	Sept. 2	Sept. 3	Slight.	Slight.	0.25	4.40	0.80	.0006	.0212	.0182	.0030	.39	.0170	.0002	2.3
6558	Oct. 2	Oct. 2	Slight.	Slight.	0.30	4.85	1.00	.0002	.0162	.0142	.0020	.39	.0150	.0001	2.2
6684	Nov. 4	Nov. 4	V. sl't.	V. sl't.	0.60	4.85	1.20	.0002	.0198	.0180	.0018	.43	.0150	.0002	2.1
6770	Dec. 2	Dec. 2	V. sl't.	V. sl't.	0.25	4.90	1.10	.0010	.0184	.0148	.0036	.48	.0200	.0003	2.1
Av.	....	....	....	....	0.44	4.70	1.25	.0004	.0187	.0163	.0024	.42	.0225	.0001	2.2

Odor, none or very faintly vegetable, rarely unpleasant.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	3	7	6	3	9	4	4	5	5
Number of sample,	4800	4899	5037	5127	5219	5316	5403	5492	5587	5737
PLANTS.										
Diatomaceæ,	**29**	**44**	**27**	**215**	**50**	**49**	**13**	**15**	**56**	**296**
Asterionella,	0	pr.	0	156	16	15	4	2	7	79
Melosira,	pr.	0	5	0	4	1	4	8	42	193
Stephanodiscus,	25	12	4	pr.	0	pr.	3	3	pr.	5
Synedra,	0	1	11	21	1	4	2	2	0	pr.
Tabellaria,	4	31	7	38	29	29	pr.	0	7	19
Cyanophyceæ,	**0**	**26**	**6**	**21**	**5**	**0**	**0**	**pr.**	**0**	**0**
Anabæna,	0	0	0	4	2	0	0	0	0	0
Chroöcoccus,	0	23	4	13	0	0	0	0	0	0
Clathrocystis,	0	3	2	2	3	pr.	0	0	0	0
Cœlosphærium,	0	pr.	pr.	2	pr.	pr.	0	pr.	0	0
Algæ,	**0**	**47**	**0**	**7**	**3**	**4**	**0**	**9**	**0**	**0**
Chlorococcus,	0	47	0	7	3	4	0	7	0	0
Cœlastrum,	0	0	0	0	0	0	0	2	0	0

BOSTON.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
ANIMALS.										
Infusoria,	**pr.**	**5**	**17**	**5**	**2**	**1**	**pr.**	**pr.**	**1**	**26**
Dinobryon,	pr.	5	17	5	2	pr.	0	0	pr.	4
Monas,	0	0	0	0	0	1	0	0	0	20
Peridinium,	0	0	0	0	pr.	0	pr.	pr.	1	2
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	29	122	50	248	60	54	13	22	57	322

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	3	5	2	6	3	2	4	2
Number of sample,	5844	5938	6029	6160	6360	6464	6558	6684	6770
PLANTS.									
Diatomaceæ,	**1,093**	**256**	**195**	**28**	**26**	**163**	**107**	**37**	**197**
Asterionella,	601	16	4	0	pr.	137	66	19	84
Melosira,	278	36	10	3	3	19	12	10	78
Stephanodiscus,	19	12	100	15	2	1	0	1	5
Synedra,	37	35	3	0	14	0	29	0	5
Tabellaria,	158	157	78	10	7	6	0	7	25
Cyanophyceæ,	**0**	**0**	**50**	**7**	**16**	**6**	**48**	**4**	**0**
Anabæna,	0	0	0	2	7	1	15	2	0
Chroöcoccus,	0	0	0	0	0	0	4	2	0
Clathrocystis,	0	0	0	2	5	5	19	pr.	0
Cœlosphærium,	0	0	50	3	4	0	10	0	0
Algæ,	**0**	**0**	**26**	**84**	**122**	**0**	**20**	**0**	**0**
Chlorococcus,	0	0	26	80	120	0	12	0	0
Cœlastrum,	0	0	0	4	2	0	8	0	0
ANIMALS.									
Infusoria,	**37**	**5**	**0**	**19**	**2**	**0**	**0**	**0**	**pr.**
Dinobryon,	0	5	0	19	2	0	0	0	pr.
Monas,	37	0	0	0	0	0	0	0	0
Peridinium,	pr.	0	0	pr.	0	0	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	1,130	261	271	138	168	169	175	41	197

COCHITUATE WORKS. — *Chemical Examination of Water from the South Boston Distributing Reservoir.*

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4848	June 18	June 19	Dist't.	Cons.	0.0	4.25	1.15	.0002	.0230	.0198	.0032	.60	.0080	.0002	–

Odor, musty. —— The sample was collected from the reservoir. This reservoir is not now in use and no change had been made in the water for a year, and very little for several years previous to the collection of the sample.

Microscopical Examination.

Algæ, *Arthrodesmus*, 1; *Raphidium*, 14; *Staurastrum*, 33. Fungi, *Leptothrix*, 2. Crustacea, *Daphnia*, pr. Total organisms, 50.

MYSTIC SUPPLY. — *Chemical Examination of Water from Mystic Lake.*

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4793	June 5	June 7	Dist't.	Slight, earthy.	0.45	–	–	.0264	.0374	.0268	.0106	1.54	.0450	.0025	–
4905	July 2	July 3	Dist't.	Slight.	0.35	–	–	.0068	.0370	.0242	.0128	1.60	.0300	.0017	–
5035	Aug. 6	Aug. 7	Slight.	Cons.	0.50	–	–	.0120	.0418	.0318	.0100	1.98	.0200	.0008	–
5142	Sept. 4	Sept. 5	Slight.	Slight.	0.28	–	–	.0008	.0252	.0190	.0062	1.96	.0180	.0006	–
5224	Oct. 3	Oct. 4	Slight.	V. sl't.	0.15	–	–	.0020	.0198	.0168	.0030	1.88	.0280	.0005	–
5314	Nov. 6	Nov. 7	V. sl't.	V. sl't.	0.25	–	–	.0092	.0200	.0168	.0032	1.94	.0420	.0005	–
5407	Dec. 3	Dec. 4	Slight.	Slight.	0.10	–	–	.0352	.0216	.0196	.0020	1.71	.0300	.0012	–
	1890.														
5500	Jan. 3	Jan. 4	Dist't.	Slight.	0.15	–	–	.0400	.0220	.0196	.0024	1.58	.0600	.0013	–
5590	Feb. 4	Feb. 5	Slight.	Slight.	0.20	–	–	.0344	.0158	.0134	.0024	1.60	.0800	.0015	–
5743	Mar. 4	Mar. 5	Dist't.	Slight.	0.20	–	–	.0400	.0278	.0198	.0080	1.53	.0800	.0012	–
5841	Apr. 1	Apr. 2	Slight.	Slight.	0.25	–	–	.0300	.0244	.0174	.0070	1.29	.0550	.0010	–
5947	May 5	May 6	Slight.	Slight.	0.03	–	–	.0120	.0152	.0122	.0030	1.30	.1250	.0007	–
6038	June 4	June 4	Slight, milky.	Slight.	0.20	–	–	.0036	.0206	.0174	.0032	1.02	.1250	.0006	–
6164	July 2	July 3	Slight.	Slight.	0.05	8.20	–	.0000	.0160	.0134	.0026	1.05	.1600	.0003	3.6
6340	Aug. 4	Aug. 4	Slight.	Slight.	0.00	10.15	2.25	.0014	.0216	.0182	.0034	1.39	.0700	.0003	3.6
6470	Sept. 3	Sept. 4	Slight.	Slight.	0.05	10.60	1.95	.0004	.0226	.0200	.0026	2.05	.0200	.0003	3.9
6565	Oct. 6	Oct. 7	Slight.	Slight.	0.05	11.00	1.40	.0004	.0204	.0140	.0064	2.28	.0400	.0002	3.8
6687	Nov. 4	Nov. 5	V. sl't.	V. sl't.	0.20	10.40	1.20	.0240	.0204	.0174	.0030	1.76	.0550	.0008	3.6
6780	Dec. 2	Dec. 3	Slight.	V. sl't.	0.15	11.10	2.10	.0496	.0402	.0364	.0038	1.96	.0850	.0018	4.0
Av.	....	....	....	....	0.19	10.65	1.78	.0173	.0247	.0197	.0050	1.65	.0615	.0009	3.7

Odor, generally very faint or none; frequently vegetable, sometimes mouldy. —— The samples were collected from the lake, near the gate-house. For analyses of samples of water from various depths in the lake, collected July 29, 1889, see special report of the State Board of Health on Water Supply and Sewerage, 1890, Part I., p. 766. For monthly record of heights of water in this lake, see page 108.

BOSTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	5	7	7	5	9	4	4	6	5
Number of sample,	4793	4905	5035	5142	5224	5314	5407	5500	5590	5743
PLANTS.										
Diatomaceæ,	9	156	31	278	11	23	60	102	246	371
Asterionella,	4	18	0	0	0	5	45	75	233	360
Diatoma,	0	0	0	0	0	0	0	0	0	0
Melosira,	0	0	0	0	pr.	3	9	7	6	4
Nitzchia,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	pr.	0	0	10	4	3	0	2	0	0
Synedra,	5	138	31	266	4	9	6	13	5	3
Tabellaria,	0	pr.	0	2	3	3	0	5	2	4
Cyanophyceæ,	0	56	31	1	pr.	pr.	0	0	0	0
Anabæna,	0	0	9	0	0	0	0	0	0	0
Chroöcoccus,	0	53	0	0	0	0	0	0	0	0
Clathrocystis,	0	2	7	0	0	pr.	0	0	0	0
Cœlosphærium,	0	1	15	1	pr.	0	0	0	0	0
Algæ,	7	215	18	4	3	2	pr.	3	2	pr.
Chlorococcus,	5	201	16	3	0	2	0	3	2	pr.
Raphidium,	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	0	pr.	2	0	3	0	pr.	0	pr.	0
Staurastrum,	2	14	0	1	0	0	0	0	0	0
Fungi. Crenothrix,	0	0	7	0	0	2	7	1	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	4	0	0	0	0	0	0
Infusoria,	2	32	7	4	2	2	pr.	0	pr.	0
Ciliated infusorian,	0	1	0	0	0	1	0	0	0	0
Dinobryon,	0	4	0	2	0	0	0	0	0	0
Peridinium,	pr.	27	7	2	1	0	0	0	pr.	0
Trachelomonas,	2	0	0	pr.	1	1	pr.	0	pr.	0
Vermes,	pr.	pr.	0	0	0	0	0	0	0	0
Anurea,	pr.	pr.	0	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0	0
Crustacea. Cyclops,	pr.	pr.	0	0	pr.	pr.	0	0	0	0
TOTAL ORGANISMS,	18	459	94	291	16	29	67	106	248	371

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	6	7	8	5	4	7	5	4
Number of sample,	5841	5947	6038	6164	6340	6470	6565	6687	6780
PLANTS.									
Diatomaceæ,	**1,336**	**1,723**	**1,088**	**326**	**8**	**7**	**92**	**27**	**129**
Asterionella,	1,330	1,715	348	42	0	0	0	2	43
Diatoma,	0	0	0	0	0	0	8	10	12
Melosira,	3	2	0	0	0	0	0	3	15
Nitzchia,	0	0	0	0	0	0	0	0	14
Stephanodiscus,	pr.	0	2	0	2	0	7	3	0
Synedra,	2	6	712	284	6	6	74	8	45
Tabellaria,	1	0	26	0	0	1	3	1	0
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**
Anabæna,	0	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0
Clathrocystis,	0	0	0	0	0	0	0	0	0
Cœlosphærium,	0	0	0	0	0	0	5	0	0
Algæ,	**3**	**pr.**	**4**	**515**	**46**	**0**	**4**	**pr.**	**47**
Chlorococcus,	3	pr.	2	488	44	0	3	0	8
Raphidium,	0	0	0	3	0	0	0	0	26
Scenedesmus,	0	0	0	3	2	0	1	pr.	13
Staurastrum,	0	0	2	21	0	0	0	0	0
Fungi. Crenothrix,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**13**
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**76**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**0**	**0**	**2**	**14**	**2**	**18**	**0**	**1**
Ciliated infusorian,	pr.	0	0	0	0	0	0	0	0
Dinobryon,	0	0	0	0	0	0	17	0	pr.
Peridinium,	0	0	0	2	12	0	0	0	0
Trachelomonas,	0	0	0	0	2	2	1	0	1
Vermes,	**0**	**0**	**0**	**0**	**0**	**1**	**6**	**0**	**0**
Anurea,	0	0	0	0	0	1	2	0	0
Rotatorian ova,	0	0	0	0	0	0	4	0	0
Crustacea. Cyclops,	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	1,339	1,723	1,092	843	144	10	125	29	190

BOSTON.

Chemical Examination of Water from College Hill Reservoir and from a faucet in Everett.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4794	June 5	June 7	Dist't.	Cons.	0.35	–	–	.0076	.0302	.0210	.0092	1.59	.0600	.0003	–
5282	Oct. 24	Oct. 25	None.	None.	0.25	–	–	.0004	.0134	–	–	–	.0420	.0001	–

Odor, none; became vegetable on heating.—— Sample No. 4794 was collected from the reservoir. No. 5282 was collected from a faucet in a house on Main Street, Everett.

Microscopical Examination.

No. 4794. Diatomaceæ, *Asterionella*, 108; *Melosira*, 1; *Stephanodiscus*, 80; *Synedra*, 480. Cyanophyceæ, *Anabæna*, pr. Algæ, *Chlorococcus*, 56; *Closterium*, 1. Infusoria, *Dinobryon*, 8; *Peridinium*, 1. Total organisms, 735.

No. 5282. Diatomaceæ, *Stephanodiscus*, 2; *Tabellaria*, 2. Algæ, *Spirotænia*, 2. Total organisms, 6.

JAMAICA POND SUPPLY. — *Chemical Examination of Water from Jamaica Pond.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4786	June 5	June 5	Dec'd.	Slight.	0.03	–	–	.0000	.1600	.0246	.1354	.83	.0030	.0002	–
4828	June 12	June 13	Dec'd.	Cons.	0.03	–	–	.0010	.1306	.0276	.1030	–	.0000	.0000	–
4860	June 20	June 20	Dec'd.	Cons.	0.08	–	–	.0004	.0722	.0342	.0380	–	.0020	.0000	–
4879	June 27	June 27	Dec'd.	Slight.	0.00	–	–	.0002	.0534	.0348	.0186	–	.0020	.0000	–
4903	July 2	July 2	Dec'd.	Slight.	0.05	–	–	.0092	.0448	.0344	.0104	–	.0030	.0002	–
5033	Aug. 6	Aug. 6	Dec'd.	V. sl't.	0.05	–	–	.0004	.0476	.0240	.0236	–	.0020	.0001	–
5129	Sept. 4	Sept. 4	Dist't.	V. sl't.	0.00	–	–	.0004	.0266	.0190	.0076	–	.0040	.0000	–
5220	Oct. 3	Oct. 3	Dist't.	V. sl't.	0.00	–	–	.0010	.0264	.0172	.0092	–	.0030	.0000	–
5305	Nov. 6	Nov. 6	Slight.	V. sl't.	0.00	–	–	.0090	.0196	.0168	.0028	–	.0120	.0003	–
5402	Dec. 3	Dec. 3	V. sl't.	Slight.	0.00	–	–	.0504	.0218	.0182	.0036	–	.0380	–	–
	1890.														
5497	Jan. 3	Jan. 3	Dist't.	Cons.	0.00	–	–	.0336	.0310	.0186	.0124	–	.0400	.0017	–
5588	Feb. 4	Feb. 4	Dist't.	Slight.	0.00	–	–	.0192	.0266	.0160	.0106	–	.0400	.0016	–
5738	Mar. 4	Mar. 4	Slight.	Cons.	0.00	–	–	.0032	.0226	.0130	.0096	.88	.0380	.0013	–
5843	Apr. 2	Apr. 2	Dist't.	Heavy.	0.00	–	–	.0004	.0364	.0164	.0200	.84	.0550	.0007	–
5941	May 5	May 5	Dist't.	Cons., white.	0.00	–	–	.0030	.0242	.0162	.0080	–	.0450	.0007	–
6036	June 4	June 4	Slight.	Slight.	0.00	–	–	.0044	.0194	.0148	.0046	.82	.0280	.0006	–
6162	July 2	July 2	V. sl't.	V. sl't.	0.00	7.30	–	.0060	.0254	.0178	.0076	.82	.0100	.0003	3.6
Av.	....	....	....	....	0.01	–	–	.0100	.0340	.0194	.0146	.84	.0228	.0006	–

Odor, generally vegetable; frequently disagreeable.—— The samples were collected from a faucet at the pumping-station, while pumping, or from the pond near the conduit. The conduit is located at a depth of 6.5 feet below high water. For analyses of the water of this pond at various depths in 1889 and 1890, see Report on Water Supply and Sewerage, 1890, Part I., pp. 756–759.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.									
	June.	June.	June.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	10	13	20	–	3	6	6	3	–	4
Number of sample,	4786	4828	4860	4879	4903	5033	5129	5220	5305	5402
PLANTS.										
Diatomaceæ,	0	0	pr.	0	5	0	1	3	–	1
Asterionella,	0	0	0	0	0	0	0	0	–	0
Synedra,	0	0	pr.	0	5	0	1	3	–	1
Cyanophyceæ. Oscillaria,	240	960	150	64	184	564	496	282	–	0
Algæ,	0	0	0	0	0	20	8	pr.	–	1
Chlorococcus,	0	0	0	0	0	19	4	0	–	0
Cœlastrum,	0	0	0	0	0	1	4	pr.	–	0
Polyedrium,	0	0	0	0	0	0	0	0	–	0
Staurastrum,	0	0	0	0	0	0	0	pr.	–	0
Zoöspores,	0	0	0	0	0	0	0	0	–	1
ANIMALS.										
Infusoria,	0	0	pr.	0	0	20	2	6	–	0
Ceratium,	0	0	pr.	0	0	20	2	2	–	0
Dinobryon,	0	0	0	0	0	0	0	4	–	0
Monas,	0	0	0	0	0	0	0	0	–	0
Peridinium,	0	0	0	0	0	0	pr.	0	–	0
Trachelomonas,	0	0	0	0	0	0	0	0	–	0
TOTAL ORGANISMS,	240	960	150	64	189	604	507	291	–	2

	1890.						
	Jan.	Feb.	Mar.	April.	May.	June.	July.
Day of examination,	4	5	5	5	6	7	2
Number of sample,	5497	5588	5738	5843	5941	6036	6162
PLANTS.							
Diatomaceæ,	25	276	1,260	4,980	1,416	64	3
Asterionella,	25	276	1,258	4,972	252	64	0
Synedra,	0	0	2	8	1,164	pr.	3
Cyanophyceæ. Oscillaria,	0	0	0	0	0	0	0
Algæ,	31	0	2	0	2	288	109
Chloroccocus,	0	0	2	0	2	260	29
Cœlastrum,	0	0	0	0	0	2	24
Polyedrium,	0	0	0	0	0	9	56
Staurastrum,	0	0	0	0	0	17	0
Zoöspores,	31	0	0	0	0	0	0

BOSTON.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.						
	Jan.	Feb.	Mar.	April.	May.	June.	July.
ANIMALS.							
Infusoria,	0	0	3	10	2	1	114
Ceratium,	0	0	0	0	0	1	6
Dinobryon,	0	0	0	0	0	0	0
Monas,	0	0	0	10	0	0	0
Peridinium,	0	0	0	0	2	0	108
Trachelomonas,	0	0	3	0	0	0	0
TOTAL ORGANISMS,	56	276	1,265	4,990	1,420	353	226

Table showing the Average Monthly Heights above tide-marsh level of the Water in the Lakes and Storage Reservoirs of the Boston Water Works, from which samples of Water were collected.

MONTHS.	Reservoir No. 2. Flash Boards. 167.12		Reservoir No. 3. Stone Crest. 175.24		Reservoir No. 4. Flash Boards. 215.21		Farm Pond. High Water. 149.25		Lake Cochituate. High Water. 134.36		Mystic Lake. High Water. 7.00	
	1889.	**1890.**	**1889.**	**1890.**	**1889.**	**1890.**	**1889.**	**1890.**	**1889.**	**1890.**	**1889.**	**1890.**
January,	–	166.12	–	175.55	–	214.53	–	149.64	–	132.49	–	5.53
February,	–	166.15	–	175.57	–	214.54	–	149.27	–	132.38	–	5.44
March,	–	164.63	–	173.92	–	213.53	–	149.54	–	132.30	–	5.15
April,	–	166.18	–	175.56	–	214.59	–	149.29	–	133.03	–	5.93
May,	–	166.57	–	175.56	–	214.54	–	149.60	–	133.82	–	6.44
June,	166.01	167.18	175.47	175.45	214.76	214.71	149.45	149.59	133.71	133.56	6.58	6.55
July,	163.52	162.37	175.43	175.17	215.01	213.90	149.36	149.15	132.85	131.99	6.63	5.73
August,	167.27	160.86	175.60	174.21	215.01	208.51	149.55	148.85	132.73	130.34	6.43	3.82
September,	167.04	164.02	175.34	175.14	215.09	202.33	149.41	149.07	130.75	129.55	6.32	3.31
October,	164.50	165.85	175.41	175.62	214.77	205.15	149.50	149.54	131.23	130.38	6.31	4.68
November,	162.70	166.13	175.54	175.52	214.57	212.53	149.36	149.19	131.77	132.47	4.01	5.65
December,	166.27	166.09	175.70	175.47	214.66	214.13	149.46	149.26	132.99	132.64	5.66	5.48

WATER SUPPLY OF BRADFORD. — BRADFORD WATER COMPANY.

Description of Works. — Population in 1890, 3,720. The works are owned by the Bradford Water Company. Water was introduced in April, 1890. The average daily consumption in the summer of 1890 was about 120,000 gallons. The sources of supply are seven wells on the southerly shore of Porter's Island in the Merrimack River, below Bradford and Haverhill, and one well on the Bradford bank of the river, opposite the island. The wells on the island are placed in a line about 1,000 feet in length, parallel to the shore and distant from it somewhat more than 100 feet. The three wells farthest up stream are 12 feet square, while all of the others are 12 feet by 24; each of the wells is about 20 feet in depth. Seven of the wells are lined and braced with spruce plank and timbers, but for the remaining one, pine was used. The bottoms of the wells are about 15 feet below ordinary water in the river. All of the wells are covered. The well on the Bradford shore is about 30 feet in depth, the lower 5 or 6 feet being in rock. This well has been used but little, and its use has been discontinued. Water is pumped from the wells to an open distributing reservoir on a hill not far from the pumping-station. The reservoir is 126 feet square at the top, 70 feet square at the bottom and 14 feet in depth at high water. Its capacity is about 1,000,000 gallons. There is also a small covered reservoir located near the open one, but at a somewhat lower level. It is 24 feet in diameter and 11 feet in depth, and holds about 40,000 gallons. The bottom and walls are covered with cement and made as nearly water-tight as possible. About one-half of the distributing mains are of cast iron, the remainder being of wrought iron lined with cement.

Chemical Examination of Water from the Well of the Bradford Water Company.

[Parts per 100,000.]

	Date of		Appearance.				Ammonia.			Nitrogen as		
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.											
4976	July 24	July 25	None.	None.	0.0	3.95	.0000	.0014	.21	.0400	.0000	1.6
	1890.											
6559	Oct. 2	Oct. 2	Very slight.	Very slight.	0.0	5.30	.0002	.0036	.34	.0150	.0001	2.6

Odor, none. —— Sample No. 4976 was collected from a tubular well on Porter's Island, during the construction of the works; No. 6559 from a faucet in the pumping-station.

Microscopical Examination.

No organisms.

BRADFORD.

Chemical Examination of Water from the Distributing Reservoir of the Bradford Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
6560	1890. Oct. 2	Oct. 2	Very slight.	Very slight.	0.0	5.65	.0002	.0076	.33	.0200	.0000	2.6

Odor, none. —— The sample was collected from the reservoir; no water had been pumped into the reservoir for 39 hours.

Microscopical Examination.

Diatomaceæ, *Synedra*, 7. Cyanophyceæ, *Clathrocystis*, 4. Algæ, *Chlorococcus*, 1. Infusoria, *Dinobryon*, 18; *Peridinium*, 43. Total organisms, 73.

WATER SUPPLY OF BRIDGEWATER AND EAST BRIDGEWATER. — THE BRIDGEWATERS WATER COMPANY.

Chemical Examination of Water from the Wells of the Bridgewaters Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
4813	1889. June 11	June 12	Very slight.	Consid'ble.	0.0	–	.0010	.0018	.51	.0250	.0001	–

Odor, none. —— The sample was collected from the well.

Microscopical Examination.

Fungi, *Crenothrix*, 5.

WATER SUPPLY OF STATE FARM, BRIDGEWATER.

Chemical Examination of Water from a faucet at the State Farm, Bridgewater.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
4913	1889. July 6	July 8	Dist't.	Cons.	1.9	–	–	.0000	.0256	.0240	.0016	–	.0100	.0001	–

Odor, none; becomes vegetable on heating. —— The sample was collected from a faucet in the office of the superintendent, the water being supplied from the Taunton River.

Microscopical Examination.

Diatomaceæ, *Ceratoneis*, pr.; *Synedra*, 7. Algæ, *Conferva*, pr. Fungi, *Crenothix*, 4; *Leptothrix*, 1. Infusoria, *Euglena*, pr.; *Monas*, pr.; *Peridinium*, pr.; *Ciliated infusorian*, pr. Total organisms, 12.

Water Supply of Brockton.

Chemical Examination of Water from Salisbury Brook at the point where it enters the Storage Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4807	June 10	June 11	V. sl't.	V. sl't.	2.3	–	–	.0024	.0402	.0354	.0048	–	.0020	.0001	–
4867	June 24	June 25	V. sl't.	None.	1.8	–	–	.0018	.0462	.0442	.0020	.26	.0020	.0001	–
4915	July 8	July 9	V. sl't.	V. sl't.	1.9	–	–	.0012	.0458	.0438	.0020	–	.0030	.0001	–
4962	July 22	July 23	V. sl't.	V. sl't.	2.5	–	–	.0024	.0536	.0528	.0008	–	.0040	.0001	–
5100	Aug. 26	Aug. 27	V. sl't.	None.	1.8	–	–	.0030	.0416	.0392	.0024	–	.0040	.0000	–
Av.	....	....	....	....	2.0	–	–	.0023	.0448	.0424	.0024	–	.0032	.0001	–

Odor, faintly vegetable. —— The samples were collected from the brook just before it enters the reservoir.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.				
	June.	June.	July.	July.	Aug.
Day of examination,	11	25	9	24	27
Number of sample,	4807	4867	4915	4962	5100
PLANTS.					
Diatomaceæ. Synedra,	1	0	1	0	pr.
Fungi. Leptothrix,	0	10	0	0	0
ANIMALS.					
Infusoria. Dinobryon,	0	0	7	0	pr.
Crustacea (several genera),	0	0	pr.	0	0
Total Organisms,	1	10	8	0	pr.

BROCKTON.

Chemical Examination of Water from Salisbury Brook Storage Reservoir, collected one foot beneath the surface.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4808	June 10	June 11	Dist't.	Slight.	1.10	–	–	.0028	.0310	.0218	.0092	–	.0020	–	–
4868	June 24	June 25	Dec'd.	Cons.	1.30	–	–	.0006	.0430	.0322	.0108	.28	.0030	.0000	–
4963	July 22	July 23	Dec'd.	Cons.	0.90	–	–	.0006	.0638	.0268	.0370	–	.0050	.0001	–
5045	Aug. 12	Aug. 13	Dist't.	Slight.	1.10	–	–	.0082	.0440	.0318	.0122	–	.0030	.0002	–
5101	Aug. 26	Aug. 27	Dist't.	Cons.	0.90	–	–	.0052	.0376	.0276	.0100	–	.0040	.0001	–
5152	Sept. 9	Sept. 10	Slight.	Slight.	0.80	–	–	.0028	.0372	.0290	.0082	–	.0040	.0001	–
5197	Sept. 23	Sept. 24	Dist't.	Slight.	1.10	–	–	.0094	.0334	.0276	.0058	–	.0090	.0001	–
5248	Oct. 11	Oct. 12	Dist't.	Slight.	1.00	–	–	.0058	.0340	.0286	.0054	–	.0090	.0002	–
5327	Nov. 11	Nov. 12	Slight.	Slight.	0.90	–	–	.0074	.0264	.0244	.0020	–	.0070	.0001	–
5378	Nov. 25	Nov. 26	V. sl't.	Slight.	1.10	–	–	.0054	.0318	.0204	.0114	–	.0060	.0001	–
5444	Dec. 16	Dec. 17	Slight.	Slight.	1.00	–	–	.0044	.0258	.0244	.0014	–	.0040	.0001	–
	1890.														
5548	Jan. 20	Jan. 21	V. sl't.	Slight.	0.90	–	–	.0020	.0252	.0232	.0020	–	.0100	.0000	–
5656	Feb. 13	Feb. 14	Slight.	Slight.	0.80	–	–	.0008	.0218	.0194	.0024	–	.0060	.0001	–
5790	Mar. 17	Mar. 18	Slight.	Slight.	1.00	–	–	.0000	.0156	.0140	.0016	.33	.0080	.0001	–
5884	Apr. 15	Apr. 16	V. sl't.	Slight.	0.45	–	–	.0006	.0182	.0142	.0040	.32	.0040	.0000	–
5993	May 19	May 20	Slight.	Cons.	0.65	–	–	.0006	.0280	.0210	.0070	.25	.0050	.0000	–
6113	June 23	June 24	Dist't.	Cons.	0.70	–	–	.0028	.0292	.0216	.0076	–	.0040	.0001	0.9
6215	July 14	July 15	Dist't.	Cons.	0.70	3.65	–	.0022	.0326	.0264	.0062	.26	.0000	.0000	1.1
6305	July 28	July 29	Dec'd.	Cons.	0.70	5.35	3.50	.0000	.0430	.0298	.0132	.29	.0000	.0002	0.9
6398	Aug. 13	Aug. 14	Dist't.	Slight.	0.75	3.85	2.05	.0076	.0308	.0262	.0046	.30	.0050	.0001	1.1
6435	Aug. 25	Aug. 26	Dist't.	Slight.	1.00	4.10	2.55	.0066	.0344	.0278	.0066	.28	.0150	.0003	1.1
6478	Sept. 8	Sept. 9	Slight.	Slight.	0.90	3.85	1.40	.0002	.0344	.0262	.0082	.28	.0100	.0001	1.1
6536	Sept. 22	Sept. 23	Slight.	Cons.	0.75	–	–	.0000	.0276	.0250	.0026	–	.0030	.0003	–
6617	Oct. 20	Oct. 21	Slight.	Cons.	0.80	3.50	1.50	.0014	.0340	.0238	.0102	.28	.0070	.0003	0.9
6618	Oct. 20	Oct. 21	Slight.	Slight.	0.75	–	–	.0008	.0292	.0206	.0086	.30	.0070	.0003	0.9
6729	Nov. 17	Nov. 18	Slight.	Slight.	0.70	3.95	1.60	.0012	.0318	.0244	.0074	.42	.0050	.0001	0.8
6823	Dec. 15	Dec. 16	V. sl't.	Slight.	0.65	3.80	1.55	.0022	.0262	.0226	.0036	.39	.0100	.0002	0.8
Av.	....	....	....	....	0.85	4.07	1.97	.0027	.0313	.0237	.0076	.31	.0059	.0001	1.0

Odor, distinctly vegetable; occasionally also grassy.—The samples were collected from the reservoir near the gate-house.

BROCKTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.										
	June.	June.	July.	Aug.	Aug.	Sept.	Sept.	Oct.	Nov.	Nov.	Dec.
Day of examination,	11	25	23	13	27	10	24	12	12	27	17
Number of sample,	4808	4868	4963	5045	5101	5152	5197	5248	5327	5378	5444
PLANTS.											
Diatomaceæ,	**25**	**704**	**126**	**14**	**14**	**408**	**54**	**162**	**378**	**104**	**26**
Asterionella,	13	400	24	0	7	8	pr.	14	66	29	11
Melosira,	5	4	0	8	0	0	39	108	274	58	5
Synedra,	0	0	0	2	0	0	1	0	0	4	pr.
Tabellaria,	7	300	102	4	7	400	14	40	38	13	10
Cyanophyceæ,	**2**	**13**	**562**	**70**	**66**	**56**	**29**	**27**	**53**	**3**	**28**
Anabæna,	1	8	352	41	32	30	20	24	2	2	pr.
Aphanocapsa,	0	0	0	0	0	0	0	0	50	pr.	28
Chroöcoccus,	0	0	128	0	0	0	0	0	0	0	0
Clathrocystis,	1	5	82	29	34	26	9	2	1	1	0
Cœlosphærium,	0	0	0	pr.	0	0	0	1	0	0	0
Algæ,	**8**	**9**	**14**	**25**	**17**	**11**	**16**	**119**	**27**	**186**	**3**
Chlorococcus,	8	7	8	25	17	0	7	99	23	163	pr.
Cœlastrum,	0	0	2	0	0	0	pr.	2	0	1	0
Eudorina,	0	0	0	0	0	0	0	0	0	0	0
Pediastrum,	0	1	4	0	pr.	0	pr.	pr.	0	0	0
Protococcus,	0	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	0	2	3	10	0	10	0
Scenedesmus,	0	pr.	0	pr.	0	1	4	8	4	9	3
Staurastrum,	0	1	0	0	0	0	0	0	0	0	0
Zoöspores,	0	0	0	0	0	8	2	0	0	3	pr.
Fungi. Crenothrix,	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**pr.**	**2**
ANIMALS.											
Infusoria,	**0**	**0**	**6**	**6**	**8**	**11**	**4**	**7**	**16**	**10**	**7**
Dinobryon,	0	0	0	pr.	0	2	1	4	15	7	7
Peridinium,	0	0	0	2	3	1	0	3	0	0	pr.
Trachelomonas,	0	0	6	4	5	8	3	pr.	1	3	0
Vermes,	**0**	**0**	**0**	**pr.**	**2**	**0**	**2**	**pr.**	**0**	**0**	**0**
Anurea,	0	0	0	pr.	1	0	pr.	0	0	0	0
Polyarthra,	0	0	0	0	1	0	pr.	0	0	0	0
Rotatorian ova,	0	0	0	pr.	0	0	2	pr.	0	0	
Crustacea,	**0**	**0**	**0**	**0**	**pr.**	**0**	**pr.**	**pr.**	**0**	**0**	**0**
Cyclops,	0	0	0	0	pr.	0	pr.	0	0	0	0
Daphnia,	0	0	0	0	0	0	pr.	pr.	0	0	0
Moina,	0	0	0	0	0	0	0	pr.	0	0	0
TOTAL ORGANISMS,	35	726	708	119	107	486	105	315	474	303	66

BROCKTON.

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1890.									
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.	Aug.	Aug.
Day of examination,	22	15	19	16	20	27	15	29	14	26
Number of sample,	5548	5656	5790	5884	5993	6113	6215	6305	6398	6435
PLANTS.										
Diatomaceæ,	**42**	**172**	**142**	**238**	**1,310**	**1,006**	**484**	**188**	**214**	**102**
Asterionella,	34	153	112	149	896	736	0	30	44	16
Melosira,	5	11	0	5	244	6	28	0	0	28
Synedra,	3	5	27	54	6	0	0	0	4	2
Tabellaria,	pr.	3	3	30	164	264	456	158	166	56
Cyanophyceæ,	**0**	**13**	**0**	**7**	**2**	**174**	**1,304**	**1,874**	**180**	**235**
Anabæna,	0	0	0	0	0	28	236	144	20	12
Aphanocapsa,	0	13	0	0	0	146	1,068	1,724	0	5
Chroöcoccus,	0	0	0	7	0	0	0	0	0	138
Clathrocystis,	0	0	0	0	2	0	0	4	140	69
Cœlosphærium,	0	0	0	0	0	0	0	2	20	11
Algæ,	**2**	**2**	**8**	**1**	**60**	**138**	**128**	**682**	**834**	**13**
Chlorococcus,	2	2	8	1	38	128	88	152	828	10
Cœlastrum,	0	0	0	0	0	0	14	0	0	0
Eudorina,	0	0	0	0	0	0	6	524	0	pr.
Pediastrum,	0	0	0	0	0	2	4	2	2	2
Protococcus,	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	10	0	0	0
Scenedesmus,	pr.	pr.	0	pr.	22	4	2	2	2	pr.
Staurastrum,	pr.	0	0	0	0	4	4	2	2	1
Zoöspores,	0	0	0	pr.	0	0	0	0	0	0
Fungi. Crenothrix,	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**1**
ANIMALS.										
Infusoria,	**pr.**	**32**	**111**	**13**	**12**	**8**	**2**	**10**	**22**	**5**
Dinobryon,	0	30	110	9	8	4	0	0	18	0
Peridinium,	pr.	0	1	4	0	0	0	2	4	4
Trachelomonas,	0	2	0	0	4	4	2	8	0	1
Vermes,	**0**	**0**	**pr.**	**0**	**2**	**0**	**2**	**0**	**0**	**pr.**
Anurea,	0	0	0	0	2	0	0	0	0	pr.
Polyarthra,	0	0	pr.	0	0	0	2	0	0	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0	0
Crustacea,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**	**pr.**	**3**
Cyclops,	0	0	0	0	0	0	0	0	pr.	0
Daphnia,	0	0	0	0	0	pr.	0	0	0	0
Moina,	0	0	0	0	0	0	0	0	0	3
TOTAL ORGANISMS,	44	221	262	259	1,386	1,326	1,920	2,756	1,250	359

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.					
	Sept.	Sept.	Oct.	Oct.	Nov.	Dec.
Day of examination,	9	23	21	21	18	17
Number of sample,	6478	6536	6617	6618	6729	6823
PLANTS.						
Diatomaceæ,	**465**	**1,385**	**120**	**278**	**252**	**203**
Asterionella,	21	13	12	62	58	112
Melosira,	0	15	89	143	126	26
Synedra,	2	1	1	7	32	48
Tabellaria,	442	1,356	18	66	36	17
Cyanophyceæ,	**162**	**23**	**1,572**	**3,233**	**0**	**13**
Anabæna,	0	0	0	0	0	0
Aphanocapsa,	0	0	0	0	0	0
Chroöcoccus,	24	0	1,572	3,232	0	13
Clathrocystis,	100	12	0	0	pr.	pr.
Cœlosphærium,	38	11	0	1	0	0
Algæ,	**761**	**807**	**6**	**19**	**3,431**	**46**
Chlorococcus,	756	788	0	1	3,424	0
Cœlastrum,	0	0	0	1	0	0
Eudorina,	0	0	0	0	0	0
Pediastrum,	1	0	1	0	0	0
Protococcus,	0	0	0	0	0	42
Raphidium,	0	0	0	13	0	0
Scenedesmus,	0	8	5	4	7	4
Staurastrum,	4	11	0	0	0	0
Zoöspores,	0	0	0	0	0	0
Fungi. Crenothrix,	**0**	**0**	**0**	**0**	**0**	**0**
ANIMALS.						
Infusoria,	**4**	**0**	**0**	**3**	**2**	**35**
Dinobryon,	1	0	0	0	0	31
Peridinium,	0	0	0	0	2	4
Trachelomonas,	3	0	0	3	0	0
Vermes,	**0**	**0**	**0**	**1**	**0**	**0**
Anurea,	0	0	0	0	0	0
Polyarthra,	0	0	0	1	0	0
Rotatorian ova,	0	0	0	0	0	pr.
Crustacea,	**pr.**	**pr.**	**0**	**0**	**pr.**	**pr.**
Cyclops,	0	0	0	0	pr.	pr.
Daphnia,	pr.	pr.	0	0	0	0
Moina,	0	0	0	0	pr.	0
TOTAL ORGANISMS,	1,392	2,215	1,698	3,534	3,685	297

BROCKTON.

Chemical Examination of Water from Salisbury Brook Storage Reservoir, collected fifteen feet beneath the surface.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4809	June 10	June 11	Dist't.	Cons.	0.90	–	–	.0100	.0264	.0224	.0040	–	.0020	.0001	–
4869	June 24	June 25	Dec'd.	Cons.	1.00	–	–	.0288	.0418	.0236	.0182	.26	.0020	.0001	–
4914	July 8	July 9	Dec'd.	Cons.	1.80	–	–	.0244	.0498	.0330	.0168	–	.0030	.0001	–
4964	July 22	July 23	Dec'd.	Cons., rusty.	2.30	–	–	.0834	.0560	.0300	.0260	–	.0070	.0001	–
5046	Aug. 12	Aug. 13	Dec'd.	Cons.	2.30	–	–	.1000	.0558	.0320	.0238	–	.0030	.0002	–
5102	Aug. 26	Aug. 27	Dec'd.	Cons.	1.10	–	–	.0290	.0442	.0300	.0142	–	.0030	.0003	–
5153	Sept. 9	Sept. 10	Dec'd.	Slight.	1.10	–	–	.0458	.0438	.0420	.0018	–	.0040	.0003	–
5198	Sept. 23	Sept. 24	Dist't.	Slight.	1.10	–	–	.0076	.0350	.0288	.0062	–	.0150	.0001	–
5249	Oct. 11	Oct. 12	Slight.	Cons.	1.00	–	–	.0058	.0354	.0294	.0060	–	.0090	.0001	–
5328	Nov. 11	Nov. 12	V. sl't.	Cons.	0.90	–	–	.0066	.0266	.0224	.0042	–	.0040	.0001	–
5379	Nov. 24	Nov. 26	V. sl't.	Slight.	1.00	–	–	.0056	.0308	.0248	.0060	–	.0060	.0001	–
5445	Dec. 16	Dec. 17	Dist't.	Cons.	1.00	–	–	.0050	.0232	.0210	.0022	–	.0050	.0001	–
	1890.														
5549	Jan. 20	Jan. 21	V. sl't.	Slight.	0.90	–	–	.0018	.0246	.0224	.0022	–	.0100	.0000	–
5657	Feb. 13	Feb. 14	Slight.	Slight.	0.90	–	–	.0004	.0252	.0206	.0046	–	.0070	.0001	–
5791	Mar. 17	Mar. 18	Slight.	Slight.	0.65	–	–	.0000	.0130	.0120	.0010	.33	.0070	.0000	–
5885	Apr. 15	Apr. 16	V. sl't.	Slight.	0.40	–	–	.0002	.0182	.0158	.0024	.29	.0020	.0000	–
5994	May 19	May 20	Slight.	Cons.	0.65	–	–	.0006	.0268	.0200	.0068	.28	.0050	.0000	–
6112	June 23	June 24	Slight.	Cons.	0.70	–	–	.0052	.0270	.0230	.0040	.36	.0030	.0002	0.8
6216	July 14	July 15	Dist't.	Slight.	0.90	–	–	.0028	.0474	.0252	.0222	.30	.0010	.0000	0.8
6306	July 28	July 29	Dist't.	Cons.	0.90	3.55	1.50	.0084	.0618	.0330	.0288	.28	.0010	.0002	1.0
6399	Aug. 13	Aug. 14	Dist't.	Slight.	0.75	–	–	.0068	.0356	.0242	.0114	–	.0050	.0001	1.1
6436	Aug. 25	Aug. 26	Dist't.	Slight.	1.00	–	–	.0058	.0334	.0272	.0062	–	.0150	.0002	–
6479	Sept. 8	Sept. 9	V. sl't.	Slight.	1.00	–	–	.0078	.0296	.0252	.0044	–	.0100	.0001	1.1
6537	Sept. 22	Sept. 23	Slight.	Cons.	0.70	–	–	.0000	.0316	.0206	.0110	.22	.0020	.0003	–
6730	Nov. 17	Nov. 18	Slight.	Cons.	0.70	3.75	1.50	.0016	.0288	.0232	.0056	.40	.0050	.0001	0.8
6822	Dec. 15	Dec. 16	V. sl't.	V. sl't.	0.65	–	–	.0026	.0262	.0250	.0012	.39	.0100	.0002	0.9
Av.	....	....	....	....	0.94	–	–	.0116	.0318	.0241	.0077	.31	.0058	.0001	0.9

Odor, distinctly vegetable, occasionally disagreeable.—— The samples were collected from the reservoir near the gate-house.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.											
	June.	June.	July.	July.	Aug.	Aug.	Sept.	Sept.	Oct.	Nov.	Nov.	Dec.
Day of examination,	11	25	9	23	13	28	10	24	12	12	27	17
Number of sample,	4809	4869	4914	4964	5046	5102	5153	5198	5249	5328	5379	5445
PLANTS.												
Diatomaceæ,	**107**	**164**	**19**	**76**	**1**	**4**	**114**	**54**	**106**	**169**	**114**	**35**
Asterionella,	58	100	0	22	0	4	0	pr.	11	85	23	17
Melosira,	45	4	0	0	0	0	0	38	75	80	69	16
Synedra,	0	0	0	0	1	0	0	0	4	1	5	pr.
Tabellaria,	4	60	19	54	0	0	114	16	16	3	17	2
Cyanophyceæ,	**1**	**2**	**113**	**546**	**77**	**876**	**518**	**17**	**28**	**20**	**17**	**pr.**
Anabæna,	0	pr.	69	18	4	0	6	12	22	3	0	pr.
Aphanocapsa,	0	0	0	0	0	0	0	0	0	16	pr.	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0	16	0
Clathrocystis,	1	2	44	528	73	876	512	5	6	1	1	0
Cœlosphærium,	0	0	0	0	0	0	0	0	0	0	0	0
Algæ,	**13**	**9**	**10**	**4**	**0**	**0**	**0**	**36**	**80**	**48**	**50**	**4**
Chlorococcus,	12	7	5	0	0	0	0	26	56	38	39	2
Pediastrum,	1	1	2	0	0	0	0	3	0	0	0	pr.
Raphidium,	0	0	0	0	0	0	0	2	19	0	2	0
Scenedesmus,	0	1	3	4	0	0	0	5	5	10	6	2
Staurogenia,	0	0	0	0	0	0	0	pr.	0	0	3	0
Fungi. Crenothrix,	**0**	**pr.**	**2**	**102**	**9**	**1**	**2**	**0**	**0**	**0**	**0**	**2**
ANIMALS.												
Rhizopoda. Arcella,	**0**	**0**	**33**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**0**	**pr.**	**pr.**	**4**	**0**	**10**	**24**	**4**	**pr.**	**10**	**7**	**0**
Dinobryon,	0	0	0	0	0	0	8	0	0	6	6	0
Monas,	0	0	0	0	0	0	0	0	0	0	pr.	0
Peridinium,	0	0	0	0	0	3	0	1	pr.	3	0	0
Trachelomonas,	0	pr.	pr.	4	0	7	16	3	pr.	1	1	0
Vermes. Rotatorian ova,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
Crustacea,	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**	**pr.**	**0**
Cyclops,	0	pr.	0	0	0	0	0	pr.	0	0	pr.	0
Daphnia,	pr.	pr.	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	121	175	177	732	87	891	658	111	216	247	188	41

BROCKTON.

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1890.									
	Jan.	Feb.	Mar.	April.	May.	June.	July.	July.	Aug.	Aug.
Day of examination,	23	15	19	16	20	27	15	29	14	26
Number of sample,	5549	5657	5791	5885	5994	6112	6216	6306	6399	6436
PLANTS.										
Diatomaceæ,	**88**	**150**	**160**	**246**	**1,188**	**264**	**694**	**246**	**92**	**117**
Asterionella,	74	142	132	167	848	208	0	40	4	33
Melosira,	8	1	0	7	304	18	18	18	0	18
Synedra,	3	3	29	54	20	2	0	8	2	2
Tabellaria,	3	4	9	18	16	36	676	180	86	64
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**2**	**1,282**	**2,770**	**104**	**341**
Anabæna,	0	0	0	0	0	2	72	0	24	22
Aphanocapsa,	0	0	0	0	0	0	1,208	2,764	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	230
Clathrocystis,	0	0	0	0	0	0	0	6	78	74
Cœlosphærium,	0	0	0	0	0	0	2	0	2	15
Algæ,	**3**	**pr.**	**0**	**5**	**102**	**58**	**40**	**102**	**228**	**2**
Chlorococcus,	2	0	0	5	98	48	32	96	226	1
Pediastrum,	0	pr.	0	0	2	0	2	2	0	1
Raphidium,	0	0	0	0	0	0	4	0	0	0
Scenedesmus,	1	0	0	pr.	2	8	2	4	2	0
Staurogenia,	0	0	0	0	0	2	0	0	0	0
Fungi. Crenothrix,	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
ANIMALS.										
Rhizopoda. Arcella,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**8**	**12**	**117**	**20**	**6**	**2**	**8**	**12**	**2**	**7**
Dinobryon,	8	9	116	16	0	0	0	2	0	0
Monas,	0	0	pr.	pr.	6	0	0	2	0	0
Peridinium,	0	0	1	3	0	0	0	0	0	5
Trachelomonas,	0	3	0	1	0	2	8	8	2	2
Vermes. Rotatorian ova,	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
Crustacea,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**
Cyclops,	0	0	0	0	0	0	0	0	0	pr.
Daphnia,	0	0	0	0	0	0	0	0	0	pr.
TOTAL ORGANISMS,	99	162	279	271	1,296	326	2,026	3,132	426	467

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.			
	Sept.	Sept.	Nov.	Dec.
Day of examination,	9	23	18	17
Number of sample,	6479	6537	6730	6822
PLANTS.				
Diatomaceæ,	**356**	**965**	**170**	**147**
Asterionella,	10	9	48	90
Melosira,	2	8	70	22
Synedra,	6	6	8	15
Tabellaria,	338	942	44	20
Cyanophyceæ,	**440**	**11**	**pr.**	**21**
Anabæna,	0	0	pr.	0
Aphanocapsa,	0	0	0	0
Chroöcoccus,	425	4	0	21
Clathrocystis,	9	5	pr.	pr.
Cœlosphærium,	6	2	0	0
Algæ,	**104**	**1,415**	**4,209**	**6**
Chlorococcus,	98	1,392	4,184	0
Pediastrum,	3	2	pr.	0
Raphidium,	0	0	11	pr.
Scenedesmus,	3	5	11	6
Staurogenia,	0	16	3	0
Fungi. Crenothrix,	**3**	**0**	**pr.**	**1**
ANIMALS.				
Rhizopoda. Arcella,	**0**	**0**	**0**	**0**
Infusoria,	**2**	**0**	**2**	**9**
Dinobryon,	0	0	2	5
Monas,	0	0	0	0
Peridinium,	0	0	0	3
Trachelomonas,	2	0	pr.	1
Vermes. Rotatorian ova,	**0**	**0**	**0**	**0**
Crustacea,	**pr.**	**pr.**	**0**	**pr.**
Cyclops,	0	0	0	pr.
Daphnia,	pr.	pr.	0	0
TOTAL ORGANISMS,	905	2,391	4,381	184

BROOKFIELD.

WATER SUPPLY OF BROOKFIELD.

Chemical Examination of Water from the Brookfield Storage Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.	Albuminoid.			Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4970	July 23	July 24	Dist't.	Cons.	0.9	6.30	3.25	.0076	.0790	.0646	.0144	–	.0020	.0001	1.7

Odor, disagreeable.—The sample was collected from the reservoir.

Microscopical Examination.

Diatomaceæ, *Synedra*, 28. Algæ, *Chlorococcus*, 8; *Staurastrum*, pr. Fungi, *Crenothrix*, 1. Infusoria, *Dinobryon*, 2; *Trachelomonas*, pr. Vermes, *Anurea*, 1; *Rotatorian ova*, 1. Crustacea, *Cyclops*, pr. Total organisms, 41.

WATER SUPPLY OF BROOKLINE.

Chemical Examination of Water from the Filter-gallery of the Brookline Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
5618	Feb. 10	Feb. 11	None.	None.	0.0	–	.0000	.0006	–	.0500	.0000	–

Odor, none.—The sample was collected from the filter-gallery.

Microscopical Examination.

Fungi, *Crenothrix*, 2.

Chemical Examination of Water from the Distributing Reservoir of the Brookline Water Works, collected near the surface.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.	Albuminoid.			Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5569	Jan. 29	Jan. 29	Slight.	Slight.	0.10	6.80	–	.0006	.0098	.0056	.0042	.51	.0230	.0002	–
5620	Feb. 10	Feb. 11	V. sl't.	Slight.	0.00	–	–	.0000	.0094	.0064	.0030	–	.0180	.0002	–
5752	Mar. 6	Mar. 6	V. sl't.	Slight.	0.00	–	–	.0006	.0118	.0046	.0072	–	.0220	.0001	–
5808	Mar. 24	Mar. 24	Slight.	Slight.	0.00	–	–	.0000	.0102	.0068	.0034	–	.0600	.0000	–
Av.	....	....	....	....	0.02	–	–	.0003	.0103	.0058	.0045	–	.0307	.0001	–

Odor, none.—The samples were collected from the reservoir, near the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.			
	Jan.	Feb.	Mar.	Mar.
Day of examination,	29	12	7	25
Number of sample,	5569	5620	5752	5808
PLANTS.				
Diatomaceæ,	**39**	**35**	**819**	**4,057**
Asterionella,	25	24	769	3,435
Cocconeis,	0	11	0	0
Melosira,	8	0	0	0
Synedra,	6	0	50	622
Cyanophyceæ,	**0**	**0**	**14**	**45**
Aphanocapsa,	0	0	14	0
Chroöcoccus,	0	0	0	45
Algæ,	**46**	**45**	**40**	**33**
Chlorococcus,	14	3	16	12
Closterium,	0	11	0	0
Eudorina,	23	28	14	21
Gonium,	9	3	10	0
ANIMALS.				
Infusoria,	**484**	**399**	**4**	**0**
Dinobryon,	483	399	0	0
Peridinium,	pr.	0	4	0
Vermes,	**0**	**0**	**6**	**2**
Anurea,	0	0	2	1
Polyarthra,	0	0	2	0
Rotatorian ova,	pr.	0	1	1
Rotifer,	0	0	1	0
Synchæta,	pr.	0	0	0
TOTAL ORGANISMS,	569	479	883	4,137

Chemical Examination of Water from the Distributing Reservoir of the Brookline Water Works, collected near the bottom.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5570	Jan. 29	Jan. 29	Dist't.	Cons.	0.10	7.35	–	.0008	.0248	.0058	.0190	.52	.0400	.0001	–
5621	Feb. 10	Feb. 11	Slight.	Slight.	0.00	–	–	.0000	.0102	.0062	.0040	–	.0220	.0001	–
5753	Mar. 6	Mar. 6	V. sl't.	Cons.	0.00	–	–	.0000	.0096	.0044	.0052	–	.0190	.0001	–
5807	Mar. 24	Mar. 24	Slight.	Slight.	0.00	–	–	.0004	.0110	.0060	.0050	–	.0450	.0001	–
Av.	....	....	....	....	0.02	–	–	.0003	.0139	.0056	.0083	–	.0315	.0001	–

Odor, cold, none or vegetable; hot, vegetable, sometimes fishy. —— The samples were collected from the reservoir, near the bottom.

BROOKLINE.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.			
	Jan.	Feb.	Mar.	Mar.
Day of examination,	29	12	7	25
Number of sample,	5570	5621	5753	5807
PLANTS.				
Diatomaceæ,	**35**	**77**	**934**	**3,042**
Asterionella,	31	52	916	2,720
Melosira,	2	0	0	0
Synedra,	2	25	18	322
Cyanophyceæ,	**0**	**0**	**48**	**60**
Aphanocapsa,	0	0	48	0
Chroöcoccus,	0	0	0	60
Algæ,	**13**	**15**	**63**	**43**
Chlorococcus,	0	2	7	16
Closterium,	0	6	3	0
Eudorina,	13	5	51	25
Gonium,	0	2	2	0
Pandorina,	0	0	pr.	2
ANIMALS.				
Infusoria,	**5,000**	**382**	**0**	**17**
Dinobryon,	0	0	0	17
Synura,	5,000	382	0	0
Vermes,	**pr.**	**0**	**pr.**	**2**
Anurea,	0	0	pr.	1
Diglena,	0	0	0	1
Rotatorian ova,	pr.	0	pr.	0
TOTAL ORGANISMS,	5,048	474	1,045	3,164

Chemical Examination of Water from the High Service Tank of the Brookline Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1890.											
5619	Feb. 10	Feb. 11	None.	Very slight.	0.0	–	.0002	.0008	–	.0400	.0000	–

Odor, none. —— The sample was collected from the high service tank.

Microscopical Examination.

Fungi, *Crenothrix*, 25.

WATER SUPPLY OF CAMBRIDGE.

Chemical Examination of Water from Fresh Pond, in Cambridge.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4787	June 6	June 6	Dist't.	Slight.	0.15	–	–	.0032	.0224	.0174	.0050	.89	.0350	.0005	5.1
4907	July 3	July 5	Dist't.	Cons.	0.15	–	–	.0070	.0268	.0208	.0060	.86	.0550	.0007	–
5039	Aug. 7	Aug. 7	Slight.	Slight.	0.10	–	–	.0028	.0216	.0186	.0030	.78	.0180	.0008	–
5148	Sept. 9	Sept. 9	Slight.	Slight.	0.10	–	–	.0018	.0214	.0182	.0032	.80	.0250	.0007	–
5228	Oct. 7	Oct. 8	Slight.	Slight.	0.03	–	–	.0036	.0262	.0182	.0080	.85	.0220	.0005	–
5317	Nov. 6	Nov. 7	Slight.	Slight.	0.20	–	–	.0360	.0206	.0152	.0054	.94	.0300	.0009	–
5408	Dec. 4	Dec. 4	Slight.	Cons.	0.10	–	–	.0304	.0276	.0184	.0092	.88	.0400	.0017	–
	1890.														
5502	Jan. 6	Jan. 7	Slight.	Cons.	0.20	–	–	.0124	.0202	.0140	.0062	.91	.0300	.0007	–
5610	Feb. 8	Feb. 8	V. sl't.	Slight.	0.20	–	–	.0130	.0182	.0142	.0040	.91	.0380	.0005	–
5745	Mar. 5	Mar. 5	V. sl't.	Cons.	0.10	–	–	.0140	.0196	.0152	.0044	.89	.0400	.0006	–
5851	Apr. 7	Apr. 7	Slight.	Slight.	0.05	–	–	.0090	.0212	.0162	.0050	.85	.0500	.0004	–
5942	May 5	May 5	Slight.	Slight.	0.05	–	–	.0022	.0214	.0154	.0060	.84	.0510	.0003	–
6037	June 4	June 4	Slight	Slight.	0.15	–	–	.0036	.0206	.0182	.0024	.88	.0450	.0005	–
6145	July 1	July 1	Dist't.	Cons.	0.10	8.75	–	.0008	.0238	.0156	.0082	.77	.0300	.0002	4.7
6338	Aug. 4	Aug. 4	Slight.	Cons.	0.00	8.75	1.70	.0014	.0260	.0218	.0042	.79	.0200	.0004	4.4
6472	Sept. 3	Sept. 4	Dist't.	Slight.	0.05	8.25	–	.0018	.0242	.0212	.0030	.78	.0070	.0002	3.1
6563	Oct. 6	Oct. 7	Slight.	Slight.	0.10	8.15	1.00	.0006	.0232	.0150	.0082	.76	.0150	.0003	4.0
6685	Nov. 4	Nov. 4	V. sl't.	V. sl't	0.15	8.50	1.20	.0362	.0226	.0170	.0056	.81	.0180	.0005	4.3
6783	Dec. 3	Dec. 3	Dist't.	Cons.	0.15	10.20	1.45	.0228	.0246	.0182	.0064	.78	.0200	.0005	4.2
Av.	....	....	....	....	0.11	8.90	1.34	.0107	.0227	.0173	.0054	.84	.0310	.0006	4.1

Odor, vegetable, sometimes also grassy. —— The samples were collected from the pump well at the pumping-station.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination, ...	10	5	7	10	8	9	5	8	8	7
Number of sample, ...	4787	4907	5039	5148	5228	5317	5408	5502	5610	5745
PLANTS.										
Diatomaceæ, ...	**223**	**25**	**6**	**4**	**30**	**127**	**1,436**	**2.276**	**101**	**117**
Asterionella, ...	3	7	0	0	2	28	1,066	1,862	84	21
Cyclotella, ...	0	0	0	0	5	0	0	0	0	0
Gyrosigma, ...	0	0	0	0	0	0	0	0	0	0
Melosira, ...	5	0	3	0	11	87	261	334	0	96
Stephanodiscus, ...	200	pr.	2	0	10	12	104	76	17	0
Synedra, ...	15	18	1	4	2	pr.	5	4	0	0
Tabellaria, ...	0	0	0	0	pr.	0	0	0	0	0
Cyanophyceæ, ...	**0**	**20**	**pr.**	**127**	**363**	**12**	**pr.**	**0**	**0**	**0**
Chroöcoccus, ...	0	0	pr.	115	348	0	0	0	0	0
Clathrocystis, ...	0	20	0	0	pr.	pr.	pr.	0	0	0
Cœlosphærium, ...	0	0	0	12	15	12	pr.	0	0	0

CAMBRIDGE.

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
PLANTS — Con.										
Algæ,	**pr.**	**24**	**0**	**7**	**23**	**32**	**257**	**82**	**0**	**97**
Chlorococcus,	0	24	0	7	17	26	257	81	0	4
Cœlastrum,	0	0	0	0	0	6	0	0	0	0
Glœocapsa,	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	0	0	0	0	0	0	0	1	0	3
Spirotænia,	pr.	0	0	0	6	0	0	0	0	40
Staurogenia,	0	0	0	0	0	0	0	0	0	50
ANIMALS.										
Infusoria,	**pr.**	**2**	**3**	**3**	**12**	**3**	**3**	**5**	**3**	**21**
Codonella,	0	0	0	0	0	0	0	0	0	0
Hydra,	0	0	3	2	8	0	0	0	0	0
Dinobryon,	0	0	0	0	2	1	1	1	0	6
Monas,	0	0	0	0	0	pr.	0	0	0	15
Peridinium,	0	0	pr.	1	0	0	0	0	3	0
Trachelomonas,	pr.	2	0	0	2	2	2	4	0	0
Vermes. Anurea,	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**
Crustacea. Cyclops,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**
TOTAL ORGANISMS,	223	71	9	141	428	174	1,696	2,363	104	235

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	8	6	7	2	5	4	7	4	4
Number of sample,	5851	5942	6037	6145	6338	6472	6563	6685	6783
PLANTS.									
Diatomaceæ,	**514**	**706**	**33**	**99**	**324**	**16**	**0**	**476**	**3,705**
Asterionella,	32	64	6	26	0	0	0	49	1,580
Cyclotella,	0	0	0	0	2	0	0	0	0
Gyrosigma,	0	0	0	0	0	0	0	0	11
Melosira,	309	427	3	50	0	0	0	374	812
Stephanodiscus,	104	75	13	9	0	0	0	40	1,064
Synedra,	63	115	0	9	322	0	0	6	14
Tabellaria,	6	25	11	5	0	16	0	7	224
Cyanophyceæ,	**0**	**pr.**	**pr.**	**322**	**8,096**	**95**	**34**	**14**	**28**
Chroöcoccus,	0	0	0	0	8,056	45	34	4	0
Clathrocystis,	0	0	pr.	236	2	0	0	6	28
Cœlosphærium,	0	pr.	pr.	86	38	50	0	4	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.									
Algæ,	**1**	**4**	**114**	**299**	**90**	**132**	**12**	**pr.**	**22**
Chlorococcus,	1	2	112	273	88	6	0	0	0
Cœlastrum,	0	0	2	26	0	0	0	0	2
Glœocapsa,	0	0	0	0	0	126	12	0	0
Scenedesmus,	0	2	pr.	0	2	0	0	pr.	20
Spirotænia,	0	0	0	0	0	0	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0
ANIMALS.									
Infusoria,	**143**	**55**	**0**	**3**	**0**	**0**	**0**	**0**	**pr.**
Codonella,	0	4	0	0	0	0	0	0	0
Hydra,	0	0	0	0	0	0	0	0	0
Dinobryon,	0	4	0	0	0	0	0	0	0
Monas,	142	41	0	1	0	0	0	0	0
Peridinium,	0	2	0	0	0	0	0	0	0
Trachelomonas,	1	4	0	2	0	0	0	0	pr.
Vermes. Anurea,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**2**
Crustacea. Cyclops,	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	658	765	147	723	8,510	243	46	490	3,757

Chemical Examination of Water from Stony Brook Storage Reservoir, in Waltham.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4815	June 11	June 12	Slight	V. sl't.	1.40	–	–	.0030	.0402	.0372	.0030	.32	.0090	.0002	–
4906	July 2	July 3	Slight.	Cons.	0.80	–	–	.0062	.0350	.0282	.0068	.37	.0180	.0003	–
5042	Aug. 7	Aug. 9	Dist't.	Slight.	1.80	–	–	.0046	.0460	.0454	.0006	.32	.0000	.0001	–
5158	Sept. 9	Sept. 10	None.	V. sl't.	0.70	–	–	.0050	.0274	.0242	.0032	.42	.0150	.0003	–
5229	Oct. 7	Oct. 8	Slight.	V. sl't.	1.10	–	–	.0044	.0324	.0290	.0034	.45	.0080	.0004	–
5322	Nov. 7	Nov. 8	Slight.	Slight.	1.20	–	–	.0026	.0222	.0204	.0018	–	.0160	.0001	–
5418	Dec. 4	Dec. 5	V. sl't.	V. sl't	0.90	–	–	.0028	.0256	.0232	.0024	.39	.0050	.0002	–
	1890.														
5505	Jan. 6	Jan. 7	V. sl't.	V. sl't.	0.60	–	–	.0020	.0154	.0144	.0010	.36	.0280	.0001	–
5599	Feb. 5	Feb. 7	V. sl't.	V. sl't.	0.55	–	–	.0006	.0144	.0112	.0032	.41	.0550	.0002	–
5754	Mar. 5	Mar. 6	V. sl't.	V sl't.	0.50	–	–	.0002	.0172	.0144	.0028	.36	.0350	.0001	–

CAMBRIDGE.

Chemical Examination of Water from Stony Brook Storage Reservoir, in Waltham — Concluded.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
5854	Apr. 7	Apr. 8	V. sl't.	Slight.	0.35	–	–	.0008	.0154	.0134	.0020	.34	.0200	.0001	–
5949	May 6	May 8	Slight.	Slight.	0.50	–	–	.0024	.0202	.0172	.0030	.37	.0200	.0001	–
6046	June 4	June 5	V. sl't.	V. sl't.	0.90	–	–	.0036	.0272	.0226	.0046	.31	.0100	.0000	–
6210	July 11	July 12	Slight.	Slight.	0.60	4.90	–	.0000	.0288	.0244	.0044	.34	.0075	.0002	2.7
6377	Aug. 6	Aug. 7	Dist't.	Cons.	0.40	6.20	2.60	.0008	.0290	.0220	.0070	.37	.0070	.0003	2.3
6471	Sept. 3	Sept. 4	Dist't.	Slight.	0.55	5.35	1.60	.0014	.0254	.0182	.0072	.40	.0030	.0001	2.2
6567	Oct. 6	Oct. 8	Slight.	Slight.	1.00	6.15	2.05	.0044	.0264	.0234	.0030	.37	.0120	.0002	2.2
6689	Nov. 4	Nov. 5	V. sl't.	V. sl't.	0.80	5.35	1.65	.0008	.0218	.0192	.0026	.42	.0200	.0002	2.2
6782	Dec. 2	Dec. 3	Slight.	V. sl't.	0.60	6.25	2.20	.0022	.0252	.0174	.0078	.43	.0320	.0002	2.3
Av.	....	....	....	....	0.80	5.86	2.02	.0025	.0261	.0224	.0037	.37	.0169	.0002	2.3

Odor, faintly vegetable. —— The samples were collected from the reservoir, near the outlet.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	12	5	10	10	8	9	5	8	7	7
Number of sample,	4815	4906	5042	5158	5229	5322	5418	5505	5599	5754
PLANTS.										
Diatomaceæ,	**26**	**96**	**0**	**65**	**182**	**202**	pr.	**2**	**1**	**4**
Asterionella,	20	43	0	58	180	202	0	0	0	0
Cyclotella,	0	0	0	0	0	0	0	0	0	0
Melosira,	4	0	0	0	0	0	0	0	0	2
Navicula,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	pr.	38	0	0	2	0	0	0	0	0
Synedra,	2	15	0	7	pr.	pr.	pr.	2	1	2
Tabellaria,	0	0	0	0	0	0	0	0	0	0
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Algæ,	**6**	**28**	**0**	**18**	**8**	**7**	pr.	**0**	**0**	**0**
Chlorococcus,	6	28	0	18	8	4	0	0	0	0
Closterium,	0	0	0	0	pr.	3	pr.	0	0	0
Glœocapsa,	0	0	0	0	0	0	0	0	0	0
Fungi. Crenothrix,	**5**	**0**	**2**	**0**	**0**	**10**	**7**	**2**	**1**	**4**

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	0	3	0	0	0	0	0
Infusoria,	pr.	3	pr.	10	17	1	0	0	13	2
Dinobryon,	pr.	0	0	9	16	0	0	0	11	2
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	0	pr.	pr.	1	0	0	0	0	2	0
Trachelomonas,	0	3	0	0	1	1	0	0	0	0
Vermes. Anurea,	0	0	0	2	0	0	0	0	0	0
TOTAL ORGANISMS,	37	127	2	95	210	220	7	4	15	10

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	6	7	12	9	4	8	5	4
Number of sample,	5854	5949	6046	6210	6377	6471	6567	6689	6782
PLANTS.									
Diatomaceæ,	10	22	26	1,392	72	30	671	20	33
Asterionella,	0	6	4	628	0	0	496	0	6
Cyclotella,	0	0	0	48	33	0	0	0	0
Melosira,	2	0	2	0	0	4	0	0	0
Navicula,	0	pr.	0	0	pr.	1	58	pr.	4
Stephanodiscus,	pr.	0	2	0	0	0	1	0	0
Synedra,	6	15	18	688	37	3	0	1	13
Tabellaria,	2	1	0	28	2	22	116	19	10
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	2	39	0	0
Algæ,	12	0	16	552	40	64	12	0	0
Chlorococcus,	12	0	16	548	40	5	12	0	0
Closterium,	0	0	0	4	pr.	11	0	0	0
Glœocapsa,	0	0	0	0	0	48	0	0	0
Fungi. Crenothrix,	2	2	0	0	0	0	4	4	10
ANIMALS.									
Rhizopoda. Actinophrys,	0	0	0	0	0	0	0	0	0
Infusoria,	1	99	4	2	5	28	3	0	pr.
Dinobryon,	0	91	0	2	0	28	0	0	0
Monas,	pr.	8	0	0	0	0	0	0	0
Peridinium,	pr.	pr.	2	0	pr.	0	0	0	pr.
Trachelomonas,	0	pr.	2	0	5	0	3	0	0
Vermes. Anurea,	pr.	0	1	0	0	0	0	0	0
TOTAL ORGANISMS,	25	123	47	1,946	117	124	729	24	43

CAMBRIDGE.

Table showing Heights of Water in Fresh Pond and Stony Brook Reservoir at the times when Samples of Water were collected for Analysis.

[Heights are in feet above Cambridge city base.]

Fresh Pond. High Water, 16.85.		Stony Brook. Rollway, 81.00.	
Date.	Height of Water.	Date.	Height of Water.
1889.		**1889.**	
June 6,	16.40	June 11,	81.16
July 3,	16.70	July 2,	80.75
Aug. 7,	16.14	Aug. 7,	81.20
Sept. 9,	15.00	Sept. 9,	80.83
Oct. 7,	14.02	Oct. 7,	81.05
Nov. 6,	14.68	Nov. 7,	81.04
Dec. 4,	16.08	Dec. 4,	81.46
1890.		**1890.**	
Jan. 6,	15.23	Jan. 6,	81.22
Feb. 8,	15.54	Feb. 5,	81.15
Mar. 5,	15.61	Mar. 5,	81.30
April 7,	16.55	April 7,	81.34
May 5,	16.40	May 6,	81.36
June 4,	15.86	June 4,	81.00
July 1,	15.67	July 11,	80.75
Aug. 4,	14.10	Aug. 6,	87.31
Sept. 3,	15.33	Sept. 3,	72.13
Oct. 6,	14.30	Oct. 6,	81.33
Nov. 4,	15.72	Nov. 4,	81.52
Dec. 3,	16.10	Dec. 2,	81.15

WATER SUPPLY OF CHICOPEE FALLS FIRE DISTRICT, CHICOPEE.

Chemical Examination of Water from the Chicopee River at Chicopee Falls.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6281	July 22	July 23	Slight.	Slight.	0.25	4.40	–	.0046	.0196	.0180	.0016	.21	.0070	.0003	1.7
6313	July 29	July 30	Slight.	Cons	0.55	4.50	1.95	.0032	.0258	.0200	.0058	.17	.0060	.0003	1.6
6367	Aug. 5	Aug. 6	V. sl't.	Slight.	0.40	4.50	1.90	.0034	.0214	.0186	.0028	.18	.0150	.0002	2.1
6444	Aug. 26	Aug. 29	Slight.	Slight.	0.40	4.60	1.95	.0030	.0224	.0166	.0058	.15	.0200	.0001	1.3
Av.	....	....	....	....	0.40	4.53	1.93	.0035	.0223	.0183	.0040	.18	.0120	.0002	1.7

Odor, faintly vegetable. —— The samples were collected from a faucet in the pumping station of the Chicopee Manufacturing Company.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.			
	July.	Aug.	Aug.	Aug.
Day of examination,	23	2	6	28
Number of sample,	6281	6313	6367	6444
PLANTS.				
Diatomaceæ,	**32**	**25**	**38**	**97**
Asterionella,	0	4	3	34
Ceratoneis,	2	0	0	0
Cymbella,	0	0	0	2
Melosira,	0	5	15	27
Meridion,	4	0	0	0
Navicula,	6	pr.	4	11
Synedra,	20	16	15	16
Tabellaria,	0	pr.	1	7
Cyanophyceæ,	**2**	**2**	**2**	**0**
Cœlosphærium,	0	2	2	0
Oscillaria,	2	0	0	0
Algæ,	**56**	**12**	**5**	**0**
Chlorococcus,	50	11	5	0
Cœlastrum,	2	1	0	0
Pediastrum,	4	0	0	0
Fungi. Crenothrix,	**20**	**0**	**4**	**0**
TOTAL ORGANISMS,	110	39	49	97

Chemical Examination of Water from Cooley Brook, in Chicopee.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
5073	Aug. 17	Aug. 19	V. sl't.	Cons.	0.45	4.45	1.15	.0002	.0138	.0090	.0048	.11	.0070	.0000	1.4

Odor, none. —— The sample was collected from the brook, near its mouth.

Microscopical Examination.

Fungi, *Crenothrix*, pr.

CHICOPEE.

Chemical Examination of Water from Poor Brook, in Chicopee.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5075	Aug. 17	Aug. 19	V. sl't.	Slight.	1.3	6.25	2.60	.0016	.0238	.0198	.0040	.13	.0060	.0001	2.3

Odor, none. —— The sample was collected from the brook, near its mouth.

Microscopical Examination.

Diatomaceæ, *Synedra*, pr. Fungi, *Crenothrix*, 4.

WATER SUPPLY OF CLINTON.

Chemical Examination of Water from the New Storage Reservoir of the Clinton Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5103	Aug. 24	Aug. 27	Slight.	Slight.	1.3	6.25	2.35	.0090	.0504	.0416	.0088	.14	.0020	.0000	2.0
5104	Aug. 24	Aug. 27	V. sl't.	Slight.	0.1	4.65	1.20	.0012	.0108	.0090	.0018	.18	.0040	.0000	1.7

Odor, slightly unpleasant. —— Sample No. 5103 was collected from the reservoir, near the dam; No. 5104 was collected from the stream, about 450 feet below the dam of the reservoir, and represents water which had filtered past the dam.

Microscopical Examination.

No. 5103. Diatomaceæ, *Synedra*, pr. Algæ, *Eudorina*, pr. Fungi, *Crenothrix*, 147. Rhizopoda, *Actinophrys*, 1. Infusoria, *Synura*, 2; *Trachelomonas*, 10. Total organisms, 160.

No. 5104. Fungi, *Crenothrix*, 93. Infusoria, *Ciliated infusorian*, pr.

WATER SUPPLY OF COHASSET. — COHASSET WATER COMPANY.

Chemical Examination of Water from the Tubular Wells of the Cohasset Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
5685	Feb. 17	Feb. 18	Very slight.	None.	0.0	–	.0000	.0048	1.48	.0150	.0003	–

Odor, none. —— The sample was collected from a faucet in the pumping-station while pumping.

Microscopical Examination.

Fungi, *Crenothrix*, 5.

COHASSET.

Chemical Examination of Water from the Distributing Reservoir of the Cohasset Water Company.

[Parts per 100,000.]

Number.	DAE OF		APPEARANCE.			Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS		Hardness.
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.	
	1890.											
5611	Feb. 9	Feb. 10	Slight.	Slight.	0.2	–	.0000	.0062	1.44	.0180	.0002	–
5612	Feb. 9	Feb. 10	Slight.	Very slight.	0.0	–	.0000	.0054	1.42	.0200	.0001	–
6144	June 27	June 28	Slight.	Slight.	0.0	16.40	.0006	.0070	–	.0050	.0000	8.4

Odor, Nos. 5611 and 5612, none cold, unpleasant when heated; No. 6144, none. —— No. 5611 was collected from the reservoir at surface; No. 5612 from the reservoir near the bottom; No. 6144 from a faucet at the Cohasset railroad station.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	February.	February.	June.
Day of examination,	11	11	28
Number of sample,	5611	5612	6144
PLANTS.			
Diatomaceæ,	**52**	**54**	**341**
Asterionella,	3	1	0
Melosira,	0	2	0
Stephanodiscus,	2	0	0
Synedra,	47	51	341
Algæ. Scenedesmus,	**0**	**pr.**	**3**
ANIMALS.			
Infusoria,	**7**	**7**	**5**
Dinobryon,	7	7	0
Peridinium,	0	0	5
TOTAL ORGANISMS,	59	61	349

WATER SUPPLY OF COTTAGE CITY. — COTTAGE CITY WATER COMPANY.

Description of Works. — Population in 1890, 1,080. The works are owned by the Cottage City Water Co. Water was introduced in June, 1890. The source of supply is the water discharged in the form of springs at the head of Lagoon Pond, near the boundary between Cottage City and Tisbury. The water is collected by means of a vitrified drain pipe, 12 inches in diameter, laid with open joints along the foot of the bluffs near the shore of the pond and below the level of high water. This pipe is 525 feet in length, its upper end being about 300 feet down the valley from the Beach Grove Spring, so called. In its course from the point of beginning to the pumping-station it crosses the lower end of a small ravine; two branches, each six inches in diameter and about 130 feet in length, built along the sides of this ravine, intercept the ground water which formerly discharged there and conduct it into the main drain pipe. Water is pumped from the pump well to the village and to an open iron tank, 20 feet in diameter and 70 feet in height, situated between the pumping-station and the village. Distributing mains are of cast iron. Service pipes are of enameled iron.

Chemical Examination of Water from Beach Grove Spring, Cottage City.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
5563	Jan. 25	Jan. 27	None.	V. sl't.	0.0	3.20	–	.0002	.0052	.0040	.0012	.93	.0070	.0000	0.8

Odor, none. —— The sample was collected from the spring.

Microscopical Examination.

Diatomaceæ, *Synedra*, pr. Algæ, *Chlorococcus*, 6; *Raphidium*, 6. Fungi, *Leptothrix*, 15. Total organisms, 27.

Chemical Examination of Water from a Brook in Cottage City.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
5567	Jan. 25	Jan. 27	None.	Slight.	0.0	3.30	0.10	.0002	.0024	.0010	.0014	.80	.0070	.0000	0.9

The sample was collected from a brook near Beach Grove Spring. The brook is fed almost entirely by springs which discharge along the slopes of a small ravine.

Microscopical Examination.

Diatomaceæ. *Synedra*, 2; *Navicula*, 2. Total organisms, 4.

WATER SUPPLY OF DANVERS.

Chemical Examination of Water from Middleton Pond, in Middleton.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Exam- ination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus- pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4806	June 8	June 10	V. sl't.	V. sl't.	0.90	–	–	.0030	.0292	.0224	.0068	.34	.0060	.0000	–
4927	July 9	July 10	V. sl't.	Slight.	0.80	–	–	.0012	.0256	.0218	.0038	–	.0040	.0000	–
5058	Aug. 13	Aug. 14	V. sl't.	Slight.	0.50	–	–	.0004	.0224	.0178	.0046	–	.0000	.0000	–
5165	Sept. 10	Sept. 12	Slight.	Slight.	0.75	–	–	.0026	.0222	.0216	.0006	–	.0040	.0001	–
5233	Oct. 8	Oct. 9	V. sl't.	V. sl't.	0.75	–	–	.0014	.0240	.0184	.0056	–	.0020	.0001	–
5335	Nov. 12	Nov. 13	V. sl't.	V. sl't.	0.80	–	–	.0010	.0250	.0226	.0024	–	.0040	.0001	–
5430	Dec. 10	Dec. 11	V. sl't.	V. sl't.	0.70	–	–	.0014	.0214	.0190	.0024	–	.0030	.0001	–
	1890.														
5519	Jan. 9	Jan. 10	V. sl't.	Cons.	1.00	–	–	.0012	.0224	.0180	.0044	–	.0040	.0001	–
5680	Feb. 15	Feb. 17	V. sl't.	Slight.	0.60	–	–	.0002	.0144	.0134	.0010	–	.0180	.0001	–
5762	Mar. 11	Mar. 12	V. sl't.	Slight.	0.70	–	–	.0008	.0192	.0168	.0024	.32	.0050	.0001	–
5873	Apr. 10	Apr. 11	V. sl't.	V. sl't.	0.55	–	–	.0014	.0184	.0140	.0044	.32	.0050	.0000	–
5971	May 12	May 14	V. sl't.	V. sl't.	0.55	–	–	.0006	.0148	.0124	.0024	.30	.0040	.0000	–
6085	June 15	June 18	None.	V. sl't.	0.60	–	–	.0036	.0182	.0158	.0024	.29	.0100	.0001	–
6193	July 8	July 9	V. sl't.	Slight.	0.60	3.40	–	.0022	.0178	.0178	.0000	.26	.0020	.0000	–
6400	Aug. 13	Aug. 14	Slight.	Slight.	0.45	3.45	1.70	.0012	.0192	.0168	.0024	.34	.0050	.0000	1.3
6487	Sept. 9	Sept. 10	V. sl't.	Slight.	0.60	3.85	1.35	.0000	.0220	.0156	.0064	.30	.0130	.0002	1.6
6581	Oct. 9	Oct. 10	V. sl't.	Slight.	0.65	4.20	1.55	.0000	.0180	.0152	.0028	.25	.0120	.0002	1.4
6707	Nov. 10	Nov. 11	V. sl't.	V. sl't.	0.70	4.60	2.25	.0014	.0184	.0164	.0020	.35	.0030	.0000	1.4
6802	Dec. 9	Dec. 11	V. sl't.	V. sl't.	0.60	4.15	1.90	.0028	.0230	.0186	.0044	.32	.0070	.0001	1.6
Av.	....	....	....	....	0.67	4.05	1.75	.0014	.0208	.0176	.0032	.31	.0058	.0001	1.5

Odor, none or faintly vegetable.——The samples were collected from a faucet in the pumping-station while pumping, or from the pond.

DANVERS.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	11	11	14	12	9	13	11	11	18	14
Number of sample,	4806	4927	5058	5165	5233	5335	5430	5519	5680	5762
PLANTS.										
Diatomaceæ,	**3**	**111**	**221**	**103**	**82**	**125**	**207**	**454**	**662**	**623**
Asterionella,	3	0	11	38	9	94	164	386	642	543
Melosira,	0	0	0	0	0	14	34	43	11	62
Stephanodiscus,	pr.	5	3	5	2	13	5	12	5	6
Synedra,	0	0	0	0	0	2	0	4	4	5
Tabellaria,	0	106	207	60	71	2	4	9	0	7
Cyanophyceæ,	**pr.**	**54**	**13**	**14**	**0**	**4**	**4**	**0**	**1**	**0**
Anabæna,	pr.	16	5	0	0	3	3	0	0	0
Aphanocapsa,	0	38	0	12	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Clathrocystis,	0	0	pr.	2	0	0	0	0	0	0
Cœlosphærium,	0	0	8	pr.	0	1	1	0	1	0
Algæ,	**2**	**149**	**49**	**68**	**0**	**pr.**	**0**	**2**	**0**	**pr.**
Chlorococcus,	2	130	49	68	0	pr.	0	2	0	0
Cœlastrum,	0	10	pr.	0	0	0	0	0	0	0
Eudorina,	0	0	0	0	0	0	0	0	0	0
Staurastrum,	0	9	0	0	0	0	0	0	0	pr.
Fungi. Crenothrix,	**2**	**0**	**0**	**1**	**0**	**pr.**	**0**	**1**	**0**	**4**
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**pr.**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**0**	**10**	**27**	**0**	**pr.**	**0**	**0**	**1**	**4**	**8**
Ciliated infusorian,	0	4	0	0	0	0	0	0	pr.	0
Dinobryon,	0	0	27	0	pr.	0	0	1	4	8
Peridinium,	0	6	0	0	0	0	0	pr.	0	0
Crustacea. Cyclops,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	7	324	310	186	82	129	211	458	667	635

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	12	16	18	10	14	10	11	11	11
Number of sample,	5873	5971	6085	6193	6400	6487	6581	6707	6802
PLANTS.									
Diatomaceæ,	**174**	**195**	**94**	**6**	**19**	**43**	**254**	**204**	**779**
Asterionella,	101	136	0	4	14	11	79	64	376
Melosira,	20	3	2	0	0	2	6	33	186
Stephanodiscus,	6	20	92	2	1	0	2	20	60
Synedra,	40	20	0	0	pr.	0	0	pr.	3
Tabellaria,	7	16	0	0	4	30	173	87	154
Cyanophyceæ,	**0**	**0**	**8**	**51**	**14**	**75**	**36**	**4**	**1**
Anabæna,	0	0	6	1	0	2	0	0	1
Aphanocapsa,	0	0	2	48	6	0	0	0	0
Chroöcoccus,	0	0	0	0	0	44	24	0	0
Clathrocystis,	0	pr.	0	1	4	12	4	0	0
Cœlosphærium,	0	pr.	pr.	1	4	17	8	4	0
Algæ,	**0**	**3**	**7**	**184**	**40**	**27**	**16**	**pr.**	**0**
Chlorococcus,	0	3	7	175	10	27	16	0	0
Cœlastrum,	0	0	pr.	9	0	0	0	0	0
Eudorina,	0	0	0	0	30	0	0	0	0
Staurastrum,	0	0	0	0	0	pr.	0	pr.	0
Fungi. Crenothrix,	**0**	**0**	**2**	**24**	**2**	**0**	**0**	**0**	**0**
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**2**	**0**
Infusoria,	**1**	**pr.**	**pr.**	**4**	**pr.**	**0**	**0**	**0**	**pr.**
Ciliated infusorian,	0	0	0	0	0	0	0	0	0
Dinobryon,	0	pr.	pr.	0	0	0	0	0	0
Peridinium,	1	0	0	4	pr.	0	0	0	pr.
Crustacea. Cyclops,	**0**	**0**	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	175	198	112	269	75	145	306	210	780

WATER SUPPLY OF EASTHAMPTON.

Chemical Examination of Water from Wilton Brook and Williston Pond, Easthampton.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889														
5105	Aug. 26	Aug. 27	V. sl't.	Slight.	0.10	–	–	.0014	.0076	.0074	.0002	–	–	.0000	–
5106	Aug. 26	Aug. 27	V. sl't.	Slight.	0.10	–	–	.0040	.0094	.0066	.0028	–	–	.0002	–
5107	Aug. 26	Aug 27	Dist't.	Cons.	0.35	–	–	.0048	.0130	.0112	.0018	–	–	.0003	–
5108	Aug. 26	Aug. 27	Slight.	Slight.	0.30	–	–	.0042	.0218	.0170	.0048	–	–	.0000	–
	1890.														
6220	July 14	July 15	Slight.	Slight.	0.20	4.95	–	.0026	.0246	.0176	.0070	.39	.0000	.0000	1.95
6264	July 18	July 21	Slight.	Slight.	0.15	4.30	–	.0068	.0302	.0184	.0118	.42	.0020	.0004	2.01

Odor, 5105 and 5106, none; 5107 and 5108, grassy, cold, unpleasant when heated.——No. 5105 was collected from Wilton Brook, near its source. No. 5106 was collected from the brook, above the cemetery. No. 5107 was collected from Wilton Brook, below the cemetery. Nos. 5108 and 6220 were collected from Williston Pond on Wilton Brook, at its outlet. No. 6264 was collected from Williston Pond, 10 feet from shore and about 25 feet from the outlet, at a depth of 2½ feet beneath the surface; the total depth at this point is 4 feet.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.				1890.	
	Aug.	Aug.	Aug.	Aug.	July.	July
Day of examination,	27	27	27	27	16	22
Number of sample,	5105	5106	5107	5108	6220	6264
PLANTS.						
Diatomaceæ,	**2**	**2**	**pr.**	**4**	**18**	**155**
Asterionella,	0	0	0	2	2	3
Navicula,	1	pr.	pr.	0	0	2
Synedra,	1	2	pr.	2	16	150
Algæ,	**0**	**1**	**0**	**2**	**5**	**29**
Chlorococcus,	0	1	0	2	1	21
Pediastrum,	0	0	0	0	4	8
Fungi. Crenothrix,	**2**	**3**	**65**	**0**	**0**	**0**
ANIMALS.						
Infusoria,	**0**	**0**	**1**	**295**	**6**	**26**
Dinobryon,	0	0	0	283	0	0
Monas,	0	0	0	0	1	1
Peridinium,	0	0	0	7	0	0
Phacus,	0	0	0	0	1	0
Trachelomonas,	0	0	1	5	4	25
Vermes,	**0**	**0**	**0**	**pr.**	**1**	**25**
Anuræa,	0	0	0	0	1	21
Monocerca,	0	0	0	0	0	2
Polyarthra,	0	0	0	pr.	0	2
Crustacea. Cyclops,	**0**	**0**	**pr.**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	4	6	66	301	30	235

EASTHAMPTON.

Chemical Examination of Water from the New Reservoir, Easthampton.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6233	July 14	July 16	None.	V. sl't.	0.0	6.40	–	.0002	.0020	–	–	.12	.0020	.0000	4.3
6234	July 15	July 16	None.	None.	0.0	5.80	–	.0000	.0044	–	–	.13	.0020	.0000	3.8

Odor, none.——No. 6233 was collected from the stream entering the new reservoir. No. 6234 was collected from a faucet in the village, the supply at the time coming apparently from the new reservoir.

Microscopical Examination.

No. 6233. No organisms.

No. 6234. Diatomaceæ, *Asterionella*, pr.; *Melosira*, 1; *Nitzchia*, pr.; *Tabellaria*, pr. Algæ, *Chlorococcus*, 1; *Pediastrum*, pr. Infusoria, *Trachelomonas*, 2. Total organisms, 4.

ESSEX.

Chemical Examination of Water from the Chebacco Ponds, in Essex.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6808	Dec. 9	Dec. 11	–	–	1.50	–	–	–	–	–	–	.88	–	–	–
6809	Dec. 9	Dec. 11	–	–	0.05	–	–	.0020	.0128	–	–	.80	–	–	–
6810	Dec. 9	Dec. 11	–	–	0.00	–	–	–	–	–	–	.81	–	–	–
6811	Dec. 9	Dec. 11	–	–	1.30	–	–	–	–	–	–	.84	–	–	–
6812	Dec. 9	Dec. 11	–	–	1.70	–	–	–	–	–	–	.86	–	–	–

No. 6808 was collected from the brook flowing from Cox's Pond near where it enters Round Pond. No. 6809 was collected from the north-westerly shore of Gravel Pond. No. 6810 was collected from Beck's Pond on the south-westerly shore, through an opening in the ice; the sample is probably, in part, ground water. No. 6811 was collected from Round Pond near the westerly shore. No. 6812 was collected from Chebacco Lake at its southerly end. The ponds were covered with about three inches of ice at the time the samples were collected.

FALMOUTH.

Chemical Examination of Water from a Tubular Well at West Falmouth.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.	
	1890.											
6395	Aug. 11	Aug. 13	Slight.	Slight.	0.90	11.50	.0032	.0074	2 58	.0100	.0001	3.64

Odor, none. —— The sample was collected from a well near Hog Island harbor, 100 feet from ordinary high tide and 50 feet from the highest tide.

Microscopical Examination.

Fungi, *Crenothrix*, 138.

WATER SUPPLY OF FITCHBURG.

Chemical Examination of Water from Scott Reservoir, Fitchburg.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4843	June 17	June 18	Slight.	Cons.	0.05	-	-	.0020	.0252	.0220	.0032	-	.0030	.0001	-
4975	July 23	July 25	Dist't.	Cons., fibr'us.	0.20	-	-	.0026	.0196	.0182	.0014	-	.0020	.0000	-
5088	Aug. 20	Aug. 21	Slight.	Cons.	0.10	-	-	.0006	.0226	.0164	.0062	-	.0050	.0000	-
5191	Sept. 17	Sept. 18	Dist't.	Cons.	0.10	-	-	.0002	.0248	.0198	.0050	-	.0030	.0000	-
5268	Oct. 16	Oct. 17	Slight.	Cons.	0.05	-	-	.0004	.0254	.0176	.0078	-	.0030	.0000	-
5369	Nov. 19	Nov. 20	Slight.	Cons.	0.10	-	-	.0000	.0220	.0164	.0056	-	.0000	.0000	-
5454	Dec. 17	Dec. 18	Slight.	Slight.	0.05	-	-	.0004	.0222	.0196	.0026	-	.0020	.0001	-
	1890.														
5560	Jan. 21	Jan. 22	Slight.	Slight.	0.10	-	-	.0000	.0144	.0104	.0040	-	.0050	.0000	-
5720	Feb. 24	Feb. 26	Slight.	V. sl't.	0.05	-	-	.0000	.0346	.0220	.0126	-	.0050	.0001	-
5806	Mar. 21	Mar. 22	V. sl't.	Slight.	0.05	-	-	.0000	.0166	.0100	.0066	.12	.0050	.0001	-
5899	Apr. 16	Apr. 17	Slight.	Slight.	0.05	-	-	.0008	.0174	.0152	.0022	.14	.0040	.0000	-
5999	May 20	May 21	Slight.	Slight.	0.05	-	-	.0000	.0164	.0110	.0054	.15	.0000	.0000	-
6136	June 25	June 26	Dist't.	Cons.	0.02	-	-	.0006	.0188	.0140	.0048	.11	.0070	.0000	0.8
6269	July 21	July 22	Dist't.	Slight.	0.05	3.25	-	.0010	.0306	.0254	.0052	.14	.0020	.0003	1.1
6430	Aug. 18	Aug. 21	Slight.	V. sl't.	0.02	2.55	1.35	.0052	.0238	.0168	.0070	.16	.0060	.0000	0.6
6513	Sept. 15	Sept. 17	Dist't.	Cons., fibr'us.	0.40	2.75	1.40	.0030	.0310	.0218	.0092	.13	.0020	.0001	1.2
6627	Oct. 20	Oct. 21	V. sl't.	Slight.	0.15	2.40	0.80	.0006	.0190	.0150	.0040	.14	.0050	.0003	0.8
6761	Nov. 25	Nov. 26	Slight.	Slight.	0.10	2.55	0.85	.0004	.0190	.0152	.0038	.15	.0080	.0001	0.9
6847	Dec. 22	Dec. 23	Slight.	Cons.	0.10	2.45	0.70	.0006	.0190	.0052	.0138	.08	.0220	.0001	0.8
Av.	....	....	....	....	0.09	2.54	1.02	.0010	.0222	.0164	.0058	.13	.0047	.0001	0.9

Odor, generally vegetable, occasionally disagreeable, rarely none. —— The samples were collected from the reservoir, near the gate-house, at a depth of one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	20	26	23	19	19	21	19	23	28	25
Number of sample,	4843	4975	5088	5191	5268	5369	5454	5560	5720	5806
PLANTS.										
Diatomaceæ,	4	985	1,290	63	206	260	54	68	0	2
Asterionella,	3	583	1,114	38	46	160	16	17	0	2
Melosira,	0	0	0	2	0	0	0	0	0	0
Navicula,	0	pr.	0	0	4	0	0	0	0	0
Synedra,	pr.	0	0	pr.	4	20	25	42	0	0
Tabellaria,	1	402	176	23	152	80	13	9	0	0
Cyanophyceæ,	0	0	472	0	0	0	60	128	0	0
Anabæna,	0	0	0	0	0	0	0	0	0	0
Aphanocapsa,	0	0	472	0	0	0	60	128	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Algæ,	pr.	0	5	716	7,464	5,240	40	15	10	0
Arthrodesmus,	0	0	0	pr.	4	0	0	1	0	0
Chlorococcus,	pr.	0	0	658	7,320	4,910	0	pr.	0	0
Pediastrum,	pr.	0	pr.	1	0	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	0	0	pr.	0	0	5	0	0	0	0
Spirotænia,	0	0	0	12	0	0	0	0	0	0
Staurastrum,	pr.	0	5	45	144	330	40	9	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0	0
Zoöspores,	0	0	0	0	0	0	0	6	10	0
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	0	0	0	0	0	0	0
Infusoria,	0	6	65	17	34	5	1	16	640	246
Dinobryon,	0	4	19	2	0	0	0	12	603	194
Monas,	0	0	0	0	0	5	0	0	0	0
Peridinium,	0	2	44	13	30	0	pr.	4	37	52
Trachelomonas,	0	0	2	2	4	0	1	0	0	0
Vermes,	pr.	0	pr.	6	2	0	0	pr.	0	pr.
Anurea,	pr.	0	pr.	2	2	0	0	0	0	pr.
Asplanchna,	0	0	0	0	0	0	0	0	0	0
Polyarthra,	0	0	0	4	0	0	0	pr.	0	0
Rotifer,	0	0	0	0	0	0	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	4	991	1,832	802	7,706	5,505	155	227	650	248

FITCHBURG.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	21	27	22	22	17	22	28	24
Number of sample,	5899	5999	6136	6269	6430	6513	6627	6761	6847
PLANTS.									
Diatomaceæ,	**165**	**324**	**140**	**78**	**22**	**308**	**143**	**1,102**	**3**
Asterionella,	52	182	116	34	8	192	44	272	1
Melosira,	0	6	4	0	0	50	0	10	0
Navicula,	0	0	0	6	0	0	7	1	0
Synedra,	43	10	4	36	14	66	86	804	pr.
Tabellaria,	70	126	16	2	0	0	6	15	2
Cyanophyceæ,	**0**	**14**	**0**	**12**	**132**	**0**	**0**	**27**	**0**
Anabæna,	0	4	0	12	132	0	0	0	0
Aphanocapsa,	0	10	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	0	27	0
Algæ,	**14**	**84**	**8**	**4**	**36**	**34**	**36**	**399**	**0**
Arthrodesmus,	0	0	0	2	0	6	4	14	0
Chlorococcus,	14	0	0	0	26	18	0	162	0
Pediastrum,	0	0	0	0	2	8	2	1	0
Raphidium,	0	0	0	0	0	0	15	132	0
Scenedesmus,	0	0	0	0	0	0	0	6	0
Spirotænia,	0	0	0	0	0	0	0	0	0
Staurastrum,	0	84	8	2	8	0	15	70	0
Staurogenia,	0	0	0	0	0	0	0	14	0
Zoöspores,	0	0	0	0	0	2	0	0	0
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**2**	**0**	pr.	**0**
Infusoria,	**108**	**254**	**2**	**4,516**	**618**	**20**	**0**	**3**	pr.
Dinobryon,	104	110	0	4,492	564	0	0	0	0
Monas,	0	0	0	0	2	0	0	0	0
Peridinium,	4	144	0	24	52	0	0	3	pr.
Trachelomonas,	0	0	2	0	0	20	0	pr.	0
Vermes,	**0**	**6**	**0**	**6**	**2**	**2**	**1**	**1**	pr.
Anurea,	0	2	0	2	0	2	0	1	pr.
Asplanchna,	0	2	0	2	0	0	0	0	0
Polyarthra,	0	0	0	2	0	0	0	0	0
Rotifer,	0	2	0	0	2	0	1	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
TOTAL ORGANISMS,	287	682	150	4,616	810	366	182	1,532	3

FITCHBURG.

Chemical Examination of Water from Overlook Reservoir, Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4842	June 17	June 18	V. sl't.	V. sl't.	0.10	–	–	.0008	.0134	.0126	.0008	–	.0020	.0001	–
5190	Sept. 17	Sept. 18	V. sl't.	Slight.	0.25	–	–	.0002	.0192	.0178	.0014	–	.0070	.0000	–
5205	Sept. 30	Oct. 1	Slight.	Slight.	0.30	–	–	.0000	.0220	.0166	.0054	–	.0020	.0000	–
5267	Oct. 16	Oct. 17	Dist't.	Cons.	0.40	–	–	.0008	.0218	.0150	.0068	–	.0030	.0000	–
5368	Nov. 19	Nov. 20	Slight.	Cons.	0.45	–	–	.0000	.0178	.0146	.0032	–	.0000	.0000	–
5453	Dec. 17	Dec. 18	V. sl't.	V. sl't.	0.25	–	–	.0008	.0218	.0200	.0018	–	.0030	.0000	–
	1890.														
5559	Jan. 21	Jan. 22	Slight.	Slight.	0.20	–	–	.0002	.0142	.0122	.0020	–	.0070	.0000	–
5719	Feb. 24	Feb. 26	Slight.	Slight.	0.10	–	–	.0036	.0328	.0304	.0024	–	.0040	.0000	–
5805	Mar. 21	Mar. 22	V. sl't.	V. sl't.	0.30	–	–	.0004	.0144	.0132	.0012	.13	.0070	.0001	–
5898	Apr. 16	Apr. 17	Slight.	Slight.	0.05	–	–	.0006	.0158	.0136	.0022	.12	.0040	.0000	–
5998	May 20	May 21	V. sl't.	Slight.	0.10	–	–	.0000	.0158	.0134	.0024	.10	.0030	.0000	–
6118	June 23	June 24	Slight.	Slight.	0.10	–	–	.0022	.0222	.0198	.0024	.08	.0025	.0003	0.4
Av.	....	....	....	....	0.21	–	–	.0009	.0191	.0165	.0026	.11	.0036	.0000	–

Odor, generally none, occasionally vegetable. —— The samples were collected from the reservoir at the gate-house one foot beneath the surface. There was complaint of a bad taste and odor in the water of the reservoir in September and October, 1889.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889. June.	1889. Sept.	1889. Oct.	1889. Oct.	1889. Nov.	1889. Dec.
Day of examination,	18	19	1	18	21	19
Number of sample,	4842	5190	5205	5267	5368	5453
PLANTS.						
Diatomaceæ,	pr.	227	165	152	107	32
Asterionella,	0	159	32	31	16	20
Melosira,	0	0	59	56	79	0
Synedra,	pr.	0	4	pr.	0	pr.
Tabellaria,	pr.	68	70	65	12	12

FITCHBURG.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.					
	June.	Sept.	Oct.	Oct.	Nov.	Dec.
Cyanophyceæ. Aphanocapsa,	0	0	0	0	0	146
Algæ. Chlorococcus,	0	97	65	242	1,106	13
ANIMALS.						
Infusoria,	0	901	910	72	1	2
Dinobryon,	0	0	146	69	0	0
Monas,	0	0	0	0	0	0
Peridinium,	0	1	0	0	1	2
Synura,	0	900	764	3	0	0
TOTAL ORGANISMS,	0	1,225	1,140	466	1,214	193

	1890.					
	Jan.	Feb.	Mar.	April.	May.	June.
Day of examination,	23	28	25	19	21	25
Number of sample,	5559	5719	5805	5898	5998	6118
PLANTS.						
Diatomaceæ,	33	0	2	38	53	4
Asterionella,	32	0	2	11	53	0
Melosira,	0	0	0	13	0	0
Synedra,	1	0	0	0	0	4
Tabellaria,	0	0	0	14	0	0
Cyanophyceæ. Aphanocapsa,	1,305	19	415	654	*3,800	554
Algæ. Chlorococcus,	0	0	0	5	0	32
ANIMALS.						
Infusoria,	16	1	11	257	4	2
Dinobryon,	13	0	11	242	3	0
Monas,	pr.	0	0	0	0	2
Peridinium,	3	1	0	15	1	0
Synura,	0	0	0	0	0	0
TOTAL ORGANISMS,	1,354	20	428	954	3,857	592

* Estimated.

Chemical Examination of Water from Falulah Reservoir, Fitchburg.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4841	June 17	June 18	Slight.	Cons.	0.20	–	–	.0024	.0196	.0154	.0042	–	.0030	.0002	–
4974	July 23	July 25	None.	V. sl't.	0.20	–	–	.0026	.0144	.0126	.0018	–	.0020	.0001	–
5087	Aug. 20	Aug. 21	V. sl't.	Slight.	0.15	–	–	.0020	.0116	.0092	.0024	–	.0040	.0001	–
5195	Sept. 20	Sept. 21	V. sl't.	Cons.	0.90	–	–	.0004	.0222	.0198	.0024	–	.0070	.0001	–
5266	Oct. 16	Oct. 17	V. sl't.	V. sl't.	0.40	–	–	.0002	.0164	.0150	.0014	–	.0030	.0000	–
5367	Nov. 19	Nov. 20	V. sl't.	None.	0.20	–	–	.0000	.0082	.0072	.0010	–	.0000	.0000	–
5452	Dec. 17	Dec. 18	V. sl't.	V. sl't.	0.05	–	–	.0016	.0164	.0138	.0026	–	.0040	.0001	–
	1890.														
5558	Jan. 21	Jan. 22	None.	V. sl't.	0.10	–	–	.0008	.0256	.0200	.0056	–	.0060	.0000	–
5718	Feb. 24	Feb. 26	None.	V. sl't.	0.05	–	–	.0010	.0164	.0138	.0026	–	.0090	.0000	–
5804	Mar. 21	Mar. 22	V. sl't.	V. sl't	0.30	–	–	.0006	.0130	.0120	.0010	–	.0030	.0000	–
5897	Apr. 16	Apr. 17	V. sl't.	V. sl't.	0.10	–	–	.0002	.0178	.0162	.0016	.10	.0080	.0000	–
5997	May 20	May 21	V. sl't.	V sl't.	0.20	–	–	.0012	.0168	.0136	.0032	.08	.0030	.0000	–
6117	June 23	June 24	Dist't.	Slight.	0.20	–	–	.0026	.0258	.0198	.0060	.08	.0070	.0002	–
6268	July 21	July 22	None.	Slight.	0.05	3.05	–	.0006	.0098	.0098	.0000	.22	.0050	.0003	1.0
6431	Aug. 18	Aug. 21	V. sl't.	Cons., earthy.	0.20	3.45	1.30	.0000	.0098	.0078	.0020	.14	.0120	.0001	1.3
6514	Sept. 15	Sept. 17	Slight.	Cons.	0.10	3.40	1.50	.0066	.0182	.0158	.0024	.10	.0050	.0001	1.3
6626	Oct. 20	Oct. 21	V. sl't.	V. sl't.	0.50	2.55	1.15	.0004	.0164	.0144	.0020	.11	.0050	.0003	0.9
6762	Nov. 25	Nov. 26	Slight.	Slight.	0.10	3.05	0.95	.0002	.0184	.0158	.0026	.15	.0120	.0002	0.8
6846	Dec. 22	Dec. 23	Slight.	Cons.	0.10	2.55	0.75	.0006	.0080	.0060	.0020	.09	.0150	.0001	0.8
Av.	....	....	....	....	0.22	3.00	1.13	.0013	.0160	.0136	.0024	.12	.0059	.0001	0.6

Odor, generally faintly vegetable, frequently none.—— The samples were collected from the reservoir near the gate-house, with the exception of Nos. 4974 and 6268 which were collected from the brook where it enters the reservoir. The reservoir was not in use July 17 to Sept. 17, 1889.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	18	24	22	24	19	21	19	23	28	25
Number of sample,	4841	4974	5087	5195	5266	5367	5452	5558	5718	5804
PLANTS.										
Diatomaceæ,	**42**	**1**	**25**	**6**	**pr.**	**8**	**3**	**3**	**1**	**3**
Asterionella,	0	0	0	0	0	0	pr.	2	0	0
Melosira,	10	0	0	1	0	4	0	0	0	0
Navicula,	0	1	1	0	0	0	pr.	pr.	0	0
Synedra,	30	pr.	24	4	pr.	4	1	1	1	3
Tabellaria,	2	0	0	1	0	0	2	0	0	0
Cyanophyceæ. Aphanocapsa,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**6**	**0**
Algæ. Chlorococcus,	**40**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Fungi,	**pr.**	**pr.**	**44**	**30**	**18**	**0**	**0**	**pr.**	**0**	**0**
Beggiatoa,	0	0	0	0	0	0	0	0	0	0
Crenothrix,	pr.	pr.	44	30	18	0	0	pr.	0	0

FITCHBURG.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
ANIMALS.										
Infusoria,	pr.	0	0	0	0	2	0	1	2	6
Dinobryon,	pr.	0	0	0	0	2	0	0	0	6
Peridinium,	0	0	0	0	0	0	0	1	2	pr.
TOTAL ORGANISMS,	82	1	69	36	18	10	3	16	9	9

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	21	25	22	22	17	22	28	24
Number of sample,	5897	5997	6117	6268	6431	6514	6626	6762	6846
PLANTS.									
Diatomaceæ,	8	21	42	2	3	0	24	76	8
Asterionella,	4	5	24	0	0	0	0	5	2
Melosira,	0	0	0	0	0	0	19	3	2
Navicula,	0	0	2	1	0	0	4	2	1
Synedra,	2	11	8	1	3	0	0	66	1
Tabellaria,	2	5	8	0	0	0	1	0	2
Cyanophyceæ. Aphanocapsa,	3	0	0	0	0	0	0	0	0
Algæ. Chlorococcus,	1	16	2	0	0	0	0	0	0
Fungi,	0	36	88	3	96	61	16	2	50
Beggiatoa,	0	0	0	0	0	0	0	0	28
Crenothrix,	0	36	88	3	96	61	16	2	22
ANIMALS.									
Infusoria,	7	5	920	0	0	0	0	0	pr.
Dinobryon,	4	3	920	0	0	0	0	0	0
Peridinium,	3	2	0	0	0	0	0	0	pr.
TOTAL ORGANISMS,	19	78	1,052	5	99	61	40	78	58

Table showing the average monthly Height of Water in Falulah, Overlook and Scott Reservoirs, Fitchburg.

The height of water in Falulah Reservoir when full is 20 feet; in Overlook and Scott Reservoirs, 40 feet.

MONTHS.	HEIGHT OF WATER IN RESERVOIRS.		
	Falulah.	Overlook.	Scott.
1889.			
June,	19.0	39.9	40.0
July,	–	34.0	39.0
August,	–	33.4	38.8
September,	6.0	30.6	35.5
October,	20.0	32.9	37.0
November,	20.0	37.9	38.5
December,	20.1	36.5	40.0

FITCHBURG.

Table showing the average monthly Height of Water in Falulah, Overlook and Scott Reservoirs, Fitchburg — Concluded.

MONTHS.	HEIGHT OF WATER IN RESERVOIRS.		
	Falulah.	Overlook.	Scott.
1890.			
January,	20.0	37.0	40.0
February,	20.1	37.2	40.0
March,	20.0	37.5	40.0
April,	20.0	39.0	40.0
May,	20.0	40.1	40.0
June,	20.0	40.0	40.0
July,	0.0	36.0	37.0
August,	11.0	33.0	32.8
September,	20.0	39.0	38.0
October,	20.2	39.5	40.0
November,	20.0	35.0	40.0

FOXBOROUGH.

Chemical Examination of Water from a Stream fed by Springs near site of Proposed Wells.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5438	Dec. 12	Dec. 13	None.	None.	0.03	3.60	0.85	.0024	.0056	.0040	.0016	.42	.0280	.0000	0.8

Odor, very faintly vegetable. —— The sample was collected from a stream fed by springs, at site of a small dam nearly opposite the house of Peter Post.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 3; *Ceratoneis*, 3; *Melosira*, 2; *Meridion*, 1; *Synedra*, pr. Total organisms, 9.

Chemical Examination of Water from a Mill Pond, in Foxborough.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5437	Dec. 12	Dec. 13	V. sl't.	V. sl't.	0.50	3.65	1.25	.0004	.0192	.0162	.0030	.29	.0020	.0001	0.6

Odor, vegetable and grassy. —— The sample was collected from the outlet of a mill pond at Lakeview.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 8; *Ceratoneis*, 1; *Epithemia*, 1; *Melosira*, 7; *Navicula*, 1; *Synedra*, 4. Algæ, *Staurastrum*, 2. Infusoria, *Dinobryon*, 12; *Monas*, pr.; *Peridinium*, 1. Vermes, *Synchæta*, pr. Total organisms, 37.

FRAMINGHAM.

WATER SUPPLY OF FRAMINGHAM.—FRAMINGHAM WATER COMPANY.

Chemical Examination of Water from the Filter-Gallery of the Framingham Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1889.											
4771	June 4	June 5	Very slight.	None.	0.0	–	.0014	.0042	.57	.0280	.0003	–
4898	July 1	July 2	None.	Very slight.	0.0	–	.0016	.0064	–	.0250	.0001	–
5024	Aug. 5	Aug. 6	None.	None.	0.0	–	.0026	.0066	.60	.0250	.0001	–
5123	Sept. 3	Sept. 4	None.	Very slight.	0.0	–	.0044	.0092	.60	.0300	.0014	–
5218	Oct. 2	Oct. 3	Slight.	Consider'ble.	0.0	–	.0020	.0046	.62	.0500	.0002	–
5303	Nov. 4	Nov. 5	Very slight.	Slight.	0.0	–	.0016	.0032	.62	.0480	.0001	–
5392	Dec. 2	Dec. 3	Very slight.	Very slight.	0.0	–	.0024	.0032	.59	.0500	.0001	–
	1890.											
5491	Jan. 2	Jan. 3	None.	Very slight.	0.0	–	.0012	.0030	.64	.0700	.0001	–
5586	Feb. 3	Feb. 4	None.	None.	0.0	–	.0006	.0004	.63	.0800	.0000	–
5741	Mar. 4	Mar. 5	None.	Very slight.	0.0	–	.0014	.0012	.61	.0520	.0000	–
5838	Apr. 1	Apr. 2	Very slight.	Very slight.	0.0	–	.0010	.0008	.67	.0900	.0000	–
5935	May 1	May 2	Very slight.	Slight.	0.0	–	.0032	.0070	.64	.0150	.0001	–
6034	June 3	June 4	Very slight.	Very slight.	0.0	6.40	.0024	.0034	.66	.0550	.0002	–
6157	July 1	July 2	None.	Very slight.	0.0	11.70	.0028	.0042	.61	.0400	.0002	2.9
6351	Aug. 4	Aug. 5	None.	None.	0.0	6.10	.0002	.0104	.70	.0100	.0007	3.0
6462	Sept. 2	Sept. 3	Very slight.	Slight.	0.0	6.00	.0042	.0064	.70	.0450	.0000	3.1
6547	Oct. 1	Oct. 2	None.	None.	0.0	6.25	.0026	.0034	.67	.0600	.0001	3.1
6683	Nov. 3	Nov. 4	Very slight.	Very slight.	0.0	6.55	.0026	.0028	.67	.1200	.0002	3.1
6769	Dec. 1	Dec. 2	Very slight.	Slight.	0.0	6.65	.0022	.0034	.63	.1200	.0001	3.1
Av..	....	....	....	....	0.0	6.32	.0021	.0044	.63	.0533	.0002	3.0

Odor, none; rarely disagreeable.—The samples were collected from the filter-gallery. For analysis of water from a dead end see Sherborn, *Reformatory Prison for Women*. For analyses of water from Farm Pond see *Boston*.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	–	3	6	6	–	–	3	4	5	5
Number of sample,	–	4898	5024	5123	5218	–	5392	5491	5586	5741
PLANTS.										
Cyanophyceæ. Oscillaria,	–	**0**	**0**	**0**	**0**	–	**0**	**0**	**0**	**0**
Fungi,	–	**29**	**3**	**2**	**36**	–	**4**	**2**	**0**	**0**
Crenothrix,	–	4	3	2	36	–	4	2	0	0
Leptothrix,	–	25	0	0	0	–	pr.	0	0	0
TOTAL ORGANISMS,	–	29	3	2	36	–	4	2	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	2	3	7	2	6	3	2	4	2
Number of sample,	5838	5935	6034	6157	6351	6462	6547	6683	6769
PLANTS.									
Cyanophyceæ. Oscillaria,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**75**
Fungi,	**1**	**0**	**120**	**63**	**pr.**	**26**	**3**	**pr.**	**3**
Crenothrix,	1	0	120	4	pr.	26	3	pr.	3
Leptothrix,	0	0	0	59	0	0	0	0	0
TOTAL ORGANISMS,	1	0	120	63	0	26	3	0	78

Chemical Examination of Water from Bannister Brook in Framingham.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4920	July 8	July 9	Slight.	Heavy.	3.30	10.85	5.50	.0012	.0466	.0406	.0060	.21	.0050	.0000	2.1
4921	July 8	July 9	Dist't.	Cons.	3.50	9.50	5.00	.0010	.0436	.0358	.0078	.26	.0060	.0000	1.7
5089	Aug. 21	Aug. 22	V. sl't.	Cons.	2.50	–	–	.0012	.0432	.0384	.0048	.26	.0050	.0001	–
5199	Sept. 23	Sept. 24	V. sl't.	Slight.	3.30	–	–	.0020	.0396	.0358	.0038	.34	.0090	.0000	–
5284	Oct. 29	Oct. 30	V. sl't.	V. sl't.	1.10	–	–	.0038	.0254	–	–	.64	.0040	.0001	3.2
5306	Nov. 5	Nov. 6	V. sl't.	Slight.	2.30	–	–	.0052	.0276	.0262	.0014	.38	.0070	.0001	–
5404	Dec. 3	Dec. 4	V. sl't.	Slight.	1.50	–	–	.0060	.0246	.0216	.0030	.29	.0130	.0001	–
5446	Dec. 16	Dec. 17	V. sl't.	Slight.	1.10	–	–	.0050	.0216	.0196	.0020	.32	.0080	.0001	–
	1890.														
5504	Jan. 6	Jan. 7	None.	Cons., earthy.	1.20	–	–	.0006	.0182	.0154	.0028	.31	.0150	.0001	–
5571	Jan. 29	Jan. 30	Slight.	Much.	1.40	–	–	.0016	.0234	.0168	.0066	.33	.0200	.0001	–
5653	Feb. 13	Feb. 14	Slight.	Slight	1.10	–	–	.0014	.0192	.0154	.0038	.31	.0100	.0000	–
5763	Mar. 11	Mar. 12	V. sl't.	Cons.	1.00	–	–	.0004	.0188	.0152	.0036	.26	.0150	.0001	–
5936	May 1	May 2	Slight.	Cons.	2.30	–	–	.0008	.0278	.0238	.0040	.19	.0040	.0000	–
6028	June 2	June 3	Slight.	Cons.	3.00	5.90	2.85	.0024	.0372	.0312	.0060	.30	.0200	.0000	–
6158	July 1	July 2	V. sl't.	Slight.	1.30	6.00	–	.0030	.0286	.0272	.0014	.26	.0025	.0002	1.6
6353	Aug. 4	Aug. 5	Slight.	Cons.	1.30	6.25	2.60	.0046	.0354	.0304	.0050	.42	.0120	.0003	2.1
6466	Sept. 2	Sept. 3	Slight.	Cons.	1.00	6.00	1.50	.0048	.0252	.0234	.0018	.44	.0150	.0001	2.3
Av.	....	....	....	....	1.89	7.70	3.49	.0026	.0300	.0260	.0040	.31	.0100	.0001	2.2

Odor, vegetable. —— The samples were collected from the brook below the field used for the disposal of the Framingham sewage, generally at the first road crossing below the field. No. 4920 was collected about half-way between the field and the road. The brook was very high on account of rain at the times when samples numbered 5089, 5199 and 5404 were collected. Sewage was first pumped to the field in the latter part of 1889.

FRAMINGHAM.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							
	July.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Dec.
Day of examination,	10	10	23	26	–	–	4	17
Number of sample,	4920	4921	5089	5199	5284	5306	5404	5446
PLANTS.								
Diatomaceæ,	3	pr.	1	3	–	–	0	1
Meridion,	0	0	0	0	–	–	0	0
Navicula,	0	pr.	pr.	0	–	–	0	0
Synedra,	3	0	1	3	–	–	0	1
Algæ. Chlorococcus,	12	335	0	8	–	–	0	0
Fungi. Crenothrix,	76	13	143	41	–	–	2	2
ANIMALS.								
Infusoria. Euglena,	0	9	0	0	–	–	0	0
Total Organisms,	91	357	144	52	–	–	2	3

	1890.								
	Jan.	Feb.	Feb.	Mar.	May.	June.	July.	Aug.	Sept.
Day of examination,	8	4	15	14	3	5	2	6	3
Number of sample,	5504	5571	5653	5763	5936	6028	6158	6353	6466
PLANTS.									
Diatomaceæ,	10	3	6	12	9	4	1	pr.	0
Meridion,	2	2	2	5	1	pr.	0	0	0
Navicula,	4	pr.	1	1	0	0	pr.	pr.	0
Synedra,	4	1	3	6	8	4	1	pr.	0
Algæ. Chlorococcus,	1	0	0	0	0	1	0	0	0
Fungi. Crenothrix,	6	4	5	5	5	3	103	76	42
ANIMALS.									
Infusoria. Euglena,	0	0	0	0	0	0	0	0	0
Total Organisms,	17	7	11	17	14	8	104	76	42

FRAMINGHAM.

Chemical Examination of Water from the Underdrain of the Framingham Sewerage System.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1889.											
5271	Oct. 22	Oct. 23	Slight.	Consider'ble.	0.00	19.70	.0800	.0080	3.73	.4750	.0045	6.6
	1890.											
5547	Jan. 20	Jan. 21	Slight.	Consider'ble.	0.00	17.70	.1040	.0080	3.82	.6500	.0021	–
5654	Feb. 13	Feb. 14	Very slight.	Slight.	0.00	18.45	.0900	.0070	3.54	.3750	.0021	–
5764	Mar. 11	Mar. 12	Very slight.	Consider'ble.	0.00	16.85	.0960	.0100	3.62	.5000	.0019	–
5839	Apr. 1	Apr. 2	Very slight.	Slight.	0.00	17.45	.0680	.0050	2.44	.4500	.0015	–
5937	May 1	May 2	Very slight.	Slight.	0.00	–	.0640	.0080	3.20	.5000	.0022	–
6027	June 2	June 3	Very slight.	Slight.	0.00	16.70	.0800	.0040	3.44	.6250	.0027	–
a	June 16	June 18	Very slight.	Consider'ble.	0.05	18.95	.0560	.0060	3.34	.6500	.0025	9.1
6159	July 1	July 2	Slight.	Consider'ble.	0.00	20.05	.0910	.0120	3.52	.4545	.0054	8.7
b	July 26	July 28	Very slight.	Consider'ble.	0.03	23.20	.0600	.0100	3.68	.5500	.0042	8.8
6354	Aug. 4	Aug. 5	Very slight.	Consider'ble.	0.00	22.00	.0600	.0080	3.79	.4545	.0043	8.0
6380	Aug. 8	Aug. 9	Slight.	Consider'ble.	0.00	23.00	.0648	.0058	3.62	.6000	.0036	7.0
c	Aug. 14	Aug. 15	Slight.	Consider'ble.	0.03	20.10	.0600	.0070	3.59	.6000	.0031	8.8
6467	Sept. 2	Sept. 3	Slight.	Consider'ble.	0.00	24.20	.0640	.0070	3.70	.5000	.0030	7.6
d	Sept. 15	Sept. 16	Slight.	Slight.	0.04	24.40	.0680	.0060	3.62	.5750	.0025	–
e	Oct. 14	Oct. 15	Very slight.	Slight.	0.03	21.00	.1000	.0050	3.85	.5500	.0027	8.2
f	Nov. 17	Nov. 18	Very slight.	Slight.	0.02	20.30	.0950	.0070	3.75	.6000	.0021	8.7
g	Dec. 15	Dec. 16	None.	Slight.	0.02	19.60	.1000	.0080	3.59	.5500	.0025	8.6
Av.	....	....	....	....	0.01	20.21	.0778	.0073	3.55	.5366	.0029	8.4

Odor, generally musty and disagreeable. —— The samples were collected from the underdrain of the Framingham sewerage system at the northerly side of Waverley Street, near the pumping-station. No. 5271 was collected before any sewage was admitted to the sewers.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.	1890.									
	Oct.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Aug.	Sept.
Day of examination, . .	–	22	15	14	2	3	4	2	6	9	3
Number of sample, . .	5271	5547	5654	5764	5839	5937	6027	6159	6354	6380	6467
PLANTS.											
Fungi. Crenothrix, .	–	*3,000	*1,500	*900	80	*10	35	0	*1,500	*400	65

* Estimated.

FRAMINGHAM.

Chemical Examination of Water from Wells at the Framingham Normal School.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.	
	1889.											
4998	July 30	Aug. 1	None.	Slight.	0.0	10.20	.0004	.0074	1.40	.0350	.0000	5.1
4999	July 30	Aug. 1	None.	None.	0.0	7.10	.0000	.0018	0.80	.1400	.0004	3.4
5000	July 30	Aug. 1	None.	Slight.	0.0	4.65	.0000	.0028	0.41	.0200	.0000	1.6
	1890.											
5543	Jan. 17	Jan. 18	Slight.	Very slight.	0.0	16.40	.0000	.0038	3.30	.0100	.0000	7.3
5544	Jan. 17	Jan. 18	None.	Slight.	0.0	4.00	.0000	.0016	0.51	.0040	.0000	2.1
5545	Jan. 17	Jan. 18	None.	None.	0.0	6.60	.0000	.0026	0.83	.0400	.0000	2.3
5914	Apr. 29	Apr. 30	Very slight.	Slight.	0.0	4.60	.0002	.0028	0.54	.0200	.0000	2.5

Odor, very faint or none.—— Samples 4998 and 5543 were collected from the well in the rear of Normal Hall. Samples numbered 5000, 5544 and 5914 were collected from the tubular wells near the windmill. Sample No. 4999 was collected from the pump connected with a well under the foundation of May Hall. Sample No. 5545 was collected from the pump at the engineer's house, near the sewage-disposal area of the school.

Microscopical Examination.

Nos. 4998, 4999, 5000, 5543 and 5545. No organisms. No. 5544. Fungi, *Crenothrix*, 1,000 (estimated). No. 5914. Not examined.

WATER SUPPLY OF GLOUCESTER. — GLOUCESTER WATER COMPANY.

Chemical Examination of Water from Dike's Brook Storage Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4797	June 6	June 7	V. sl't.	V. sl't.	0.30	–	–	.0044	.0176	.0140	.0036	.75	.0020	.0002	–
4926	July 9	July 10	Dist't.	He'vy.	0.40	–	–	.0158	.0258	.0186	.0072	–	.0050	.0000	–
5038	Aug. 7	Aug. 7	Dist't.	He'vy.	0.90	–	–	.0198	.0358	.0222	.0136	–	.0020	.0000	–
5151	Sept. 9	Sept. 10	Slight.	Very heavy.	2.50	–	–	.0226	.0344	.0272	.0072	–	.0030	.0001	–
5238	Oct. 9	Oct. 9	V. sl't.	None.	0.65	–	–	.0088	.0220	.0192	.0028	–	.0070	.0004	–
5321	Nov. 7	Nov. 8	V. sl't.	V. sl't.	0.70	–	–	.0122	.0218	.0196	.0022	–	.0080	.0001	–
5415	Dec. 4	Dec. 5	V. sl't.	V. sl't.	0.40	–	–	.0032	.0204	.0178	.0026	–	.0070	.0002	–
	1890.														
5503	Jan. 6	Jan. 7	Slight.	V. sl't.	0.60	–	–	.0002	.0242	.0150	.0092	–	.0060	.0000	–
5601	Feb. 6	Feb. 7	V. sl't.	Slight.	0.40	–	–	.0006	.0176	.0136	.0040	–	.0120	.0001	–
5751	Mar. 5	Mar. 6	V. sl't.	V. sl't.	0.40	–	–	.0000	.0138	.0112	.0026	.77	.0060	.0000	–
5852	Apr. 7	Apr. 8	V. sl't.	V. sl't.	0.30	–	–	.0006	.0184	.0152	.0032	.71	.0030	.0000	–
5948	May 6	May 7	Slight.	V. sl't.	0.30	–	–	.0008	.0160	.0130	.0030	.69	.0030	.0000	–
6047	June 5	June 6	V. sl't.	V. sl't.	0.30	–	–	.0034	.0120	.0116	.0004	.73	.0020	.0004	–
6224	July 14	July 15	Slight.	Cons.	0.50	4.30	–	.0090	.0178	.0146	.0032	.71	.0000	.0000	0.8
6370	Aug. 6	Aug. 6	V. sl't.	V. sl't.	0.35	4.55	1.50	.0144	.0226	.0172	.0054	.72	.0035	.0000	1.6
6477	Sept. 8	Sept. 9	V. sl't.	V. sl't.	0.60	5.20	1.50	.0002	.0228	.0176	.0052	.76	.0060	.0001	1.8
6568	Oct. 7	Oct. 8	Slight.	Slight.	0.50	3.70	1.40	.0058	.0174	.0152	.0022	.67	.0080	.0002	0.9
6747	Nov. 22	Nov. 24	None.	V. sl't.	0.65	4.05	1.65	.0132	.0200	.0190	.0010	.76	.0150	.0001	1.1
6793	Dec. 8	Dec. 9	V. sl't.	None.	0.60	4.35	1.55	.0098	.0252	.0228	.0024	.75	.0200	.0000	0.9
Av.	....	....	....	....	0.60	4.37	1.52	.0076	.0213	.0171	.0042	.73	.0062	.0001	1.2

Odor, distinctly vegetable, frequently disagreeable. —— The samples were collected from a faucet at the pumping-station, while pumping.

GLOUCESTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	10	11	7	10	10	13	5	8	8
Number of sample,	4797	4926	5038	5151	5238	5321	5415	5503	5601
PLANTS.									
Diatomaceæ,	0	0	0	0	0	2	0	0	0
Asterionella,	0	0	0	0	0	2	0	0	0
Synedra,	0	0	0	0	0	0	0	0	0
Algæ,	3	0	0	0	41	35	0	25	13
Chlorococcus,	3	0	0	0	41	31	0	0	0
Closterium,	0	0	0	0	0	4	0	15	11
Cœlastrum,	0	0	0	0	pr.	0	0	0	0
Cosmarium,	0	0	0	0	0	0	0	2	0
Zoöspores,	0	0	0	0	0	0	0	8	2
Fungi. Crenothrix,	2	27	472	910	0	13	0	2	pr.
ANIMALS.									
Infusoria,	0	0	0	0	2	pr.	6	109	16
Monas,	0	0	0	0	0	0	0	0	14
Peridinium,	0	0	0	0	0	0	6	107	2
Trachelomonas,	0	0	0	0	2	pr.	pr.	2	0
Rhizopoda. Arcella,	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	5	27	472	910	43	50	6	136	29

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	7	8	6	7	16	6	9	8	24	9
Number of sample,	5751	5852	5948	6047	6224	6370	6477	6568	6747	6793
PLANTS.										
Diatomaceæ,	pr.	0	7	pr.	0	371	238	0	5	37
Asterionella,	0	0	4	pr.	0	371	0	0	1	0
Synedra,	pr.	0	3	0	0	0	238	0	4	37
Algæ,	103	78	27	266	312	0	0	3	12	28
Chlorococcus,	3	49	6	265	304	0	0	3	8	3
Closterium,	100	29	21	1	0	0	0	0	0	0
Cœlastrum,	0	0	0	0	8	0	0	0	2	0
Cosmarium,	0	0	0	0	0	0	0	0	2	20
Zoöspores,	pr.	0	0	0	0	0	0	0	0	5
Fungi. Crenothrix,	pr.	6	0	0	1,392	0	17	2	3	12

GLOUCESTER.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.										
Infusoria,	**9**	**29**	**22**	**4**	**28**	**11**	**0**	**0**	**4**	**4**
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	9	29	20	0	0	0	0	0	4	4
Trachelomonas,	0	0	2	4	28	11	0	0	pr.	pr.
Rhizopoda. Arcella,	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	112	113	56	270	1,738	382	255	5	24	81

Chemical Examination of Water from Wallace Pond.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6690	Nov. 5	Nov. 6	V. sl't.	V. sl't.	0.6	5.60	1.95	.0030	.0242	.0226	.0016	.91	.0200	.0001	1.11

Odor, none.—— The sample was collected from a faucet in the pumping-station at a time when water was being drawn from Wallace Pond.

Microscopical Examination.

Cyanophyceæ, *Chroöcoccus*, 6. Algæ, *Chlorococcus*, 9. Fungi, *Crenothrix*, pr. Infusoria, *Trachelomonas*, pr. Total organisms, 15.

Chemical Examination of Water from Alewife Brook in Gloucester.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
5814	Mar. 24	Mar. 25	V. sl't.	V. sl't.	0.8	4.80	2.10	.0002	.0122	.0106	.0016	1.18	.0070	.0000	1.1

Odor, very faintly vegetable.——The sample was collected from Alewife Brook, near the point where it is crossed by the first street in Gloucester.

Microscopical Examination.

Diatomaceæ, *Ceratoneis*, pr.; *Meridion*, 2; *Synedra*, 3. Algæ, *Chlorococcus*, 3. Fungi, *Crenothrix*, pr. Infusoria, *Ciliated infusorian*, 1; *Dinobryon*, 3; *Peridinium*, 1. Total organisms, 13.

Water Supply of Haverhill. — Haverhill Aqueduct Company.

Chemical Examination of Water from Kenoza Lake, Haverhill.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4864	June 21	June 21	V. sl't.	V. sl't.	0.05	–	–	.0008	.0142	.0130	.0012	–	.0030	.0000	–

Odor, none. —— The sample was collected from a faucet at the pumping-station.

Water Supply of Hingham. — Hingham Water Company.

Chemical Examination of Water from Accord Pond, Hingham.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4816	June 12	June 12	V. sl't.	V. sl't.	0.2	–	–	.0004	.0130	.0100	.0030	.58	.0050	.0001	–

Odor, none. —— The sample was collected from a faucet in the village.

Microscopical Examination.

Diatomaceæ, *Melosira*, 1; *Synedra*, pr. Algæ, *Chlorococcus*, pr. Fungi, *Crenothrix*, 6. Total organisms, 7.

Chemical Examination of Water from Fulling Mill-pond.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
5130	Sept. 3	Sept. 4	Dec'd.	Slight.	0.15	–	–	.0002	.0246	.0152	.0094	.73	.0030	.0000	–

Odor, faintly grassy. —— The sample was collected from Fulling Mill-pond, near the dam.

Microscopical Examination.

Diatomaceæ, *Melosira*, 26; *Navicula*, 7; *Synedra*, 226. Cyanophyceæ, *Chroöcoccus*, 27. Algæ, *Chlorococcus*, 185; *Desmidium*, 2; *Micrasterias*, 1; *Pediastrum*, 7; *Polyedrium*, 29; *Raphidium*, 14; *Scenedesmus*, 3; *Staurastrum*, 2. Infusoria, *Monas*, pr.; *Peridinium*, 85; *Trachelomonas*, 10. Vermes, *Rotatorian ova*, pr.; *Rotifer*, pr. Total organisms, 624.

HINSDALE.

WATER SUPPLY OF HINSDALE FIRE DISTRICT, HINSDALE.

Chemical Examination of Water from the Storage Reservoir of the Hinsdale Fire District.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5744	Mar. 4	Mar. 5	V. sl't.	V. sl't.	0.03	1.90	0.70	.0000	.0106	.0084	.0022	.05	.0030	.0000	1.1

Odor, none. —— The sample was collected from the middle of the reservoir, three feet below the surface.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 5; *Stephanodiscus*, 2. Infusoria, *Peridinium*, 45. Total organisms, 52.

WATER SUPPLY OF HOLYOKE.

Chemical Examination of Water from Wright and Ashley Ponds, Holyoke.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4820	June 11	June 12	Slight.	Slight.	0.00	–	–	.0034	.0184	.0144	.0040	.17	.0020	.0000	–
4955	July 17	July 18	Slight.	Slight.	0.01	–	–	.0034	.0344	.0294	.0050	–	.0050	.0001	–
5060	Aug. 14	Aug. 15	V. sl't.	V. sl't.	0.00	–	–	.0026	.0186	.0172	.0014	–	.0000	.0001	–
5180	Sept. 16	Sept. 17	Slight.	V. sl't.	0.00	–	–	.0020	.0246	.0204	.0042	–	.0000	.0000	–
5257	Oct. 15	Oct. 16	V. sl't.	Slight.	0.03	–	–	.0042	.0200	.0160	.0040	–	.0020	.0000	–
5347	Nov. 13	Nov. 14	Dist't.	Slight.	0.05	–	–	.0004	.0186	.0160	.0026	–	.0030	.0001	–
5423	Dec. 9	Dec. 10	V. sl't.	V. sl't.	0.05	–	–	.0018	.0226	.0168	.0058	–	.0050	.0001	–
	1890.														
5524	Jan. 13	Jan. 14	V. sl't.	Slight.	0.05	–	–	.0016	.0182	.0132	.0050	–	.0050	.0000	–
5646	Feb. 12	Feb. 13	Slight.	Slight.	0.00	–	–	.0002	.0270	.0188	.0082	–	.0040	.0000	–
5970	May 13	May 14	Slight.	Cons.	0.00	–	–	.0014	.0130	.0116	.0014	.13	.0020	.0000	–
6630	Oct. 22	Oct. 23	V. sl't.	V. sl't.	0.00	5.00	0.95	.0050	.0220	.0168	.0052	.13	.0080	.0001	3.5
Av.	....	....	....	....	0.02	–	–	.0024	.0216	.0173	.0043	.14	.0033	.0000	–

Odor, generally vegetable; occasionally disagreeable. —— The samples were collected from Wright Pond near the gate-house, with the exception of No. 4955, which was collected from Ashley Pond. All samples were collected near the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.			
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	May.	Oct.
Day of examination,	13	18	15	17	17	13	9	15	15	14	23
Number of sample,	4820	4955	5060	5180	5257	5347	5423	5524	5646	5970	6630
PLANTS.											
Diatomaceæ,	**2**	**41**	**7**	**7**	**88**	**582**	**332**	**214**	**22**	**133**	**50**
Asterionella,	0	0	4	0	0	7	26	44	7	59	0
Melosira,	pr.	41	3	5	66	264	224	111	6	28	33
Stephanodiscus,	2	0	pr.	0	pr.	9	10	18	7	14	pr.
Synedra,	pr.	pr.	0	pr.	15	156	19	32	2	32	2
Tabellaria,	0	0	0	2	7	146	53	9	0	pr.	15
Cyanophyceæ,	**pr.**	**0**	**6**	**59**	**8**	**8**	**pr.**	**1**	**0**	**0**	**0**
Anabæna,	0	0	pr.	55	8	5	pr.	1	0	0	0
Clathrocystis,	pr.	0	6	4	0	3	0	0	0	0	0
Algæ,	**pr.**	**29**	**0**	**19**	**5**	**51**	**18**	**6**	**0**	**4**	**3**
Chlorococcus,	pr.	29	0	19	0	43	18	6	0	4	0
Closterium,	0	0	0	0	5	8	pr.	0	0	0	3
Fungi. Beggiatoa,	**0**	**0**	**0**	**0**	**0**	**17**	**0**	**1**	**0**	**0**	**0**
ANIMALS.											
Infusoria,	**22**	**0**	**5**	**2**	**16**	**167**	**143**	**191**	**398**	**45**	**10**
Dinobryon,	pr.	0	5	0	12	166	141	189	398	44	10
Monas,	0	0	0	0	pr.	pr.	pr.	0	0	0	0
Peridinium,	22	0	0	0	0	0	0	2	pr.	1	0
Trachelomonas,	pr.	0	pr.	2	4	1	2	0	pr.	0	0
Vermes. Polyarthra,	**0**	**0**	**0**	**0**	**pr.**	**1**	**0**	**0**	**0**	**2**	**0**
TOTAL ORGANISMS,	24	70	18	87	117	826	493	413	420	184	63

Chemical Examination of Water from a Faucet in Holyoke, supplied from the Holyoke Water Works.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
5765	Mar. 11	Mar. 12	Dist't.	Cons.	0.10	–	–	.0004	.0156	.0104	.0052	.13	.0040	.0000	–
5864	Apr. 9	Apr. 10	V. sl't.	Slight.	0.05	–	–	.0006	.0124	.0094	.0030	.12	.0040	.0000	–
6738	Nov. 19	Nov. 20	Slight.	Cons., fibr'us.	0.20	5.60	1.20	.0010	.0176	.0140	.0036	.12	.0150	.0001	3.5

Odor, vegetable; somewhat unpleasant. —— The samples were collected from a faucet on Elm Street.

HOLYOKE.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	March.	April.	November.
Day of examination,	14	11	21
Number of sample,	5765	5864	6738
PLANTS.			
Diatomaceæ,	**30**	**56**	**699**
Asterionella,	0	1	298
Melosira,	16	31	206
Navicula,	1	0	3
Nitzchia,	0	0	7
Stephanodiscus,	5	17	3
Synedra,	8	7	56
Tabellaria,	0	0	126
Cyanophyceæ,	**0**	**0**	**8**
Microcystis,	0	0	5
Oscillaria,	0	0	3
Algæ,	**0**	**2**	**3**
Chlorococcus,	0	2	0
Closterium,	0	0	3
Fungi,	**23**	**2**	**34**
Crenothrix,	22	0	34
Leptothrix,	1	2	0
ANIMALS.			
Infusoria,	**19**	**8**	**29**
Ciliated infusorian,	1	0	0
Dinobryon,	12	7	22
Monas,	0	1	0
Peridinium,	1	pr.	0
Trachelomonas,	5	0	7
Vermes. Notommata,	**1**	**0**	**0**
TOTAL ORGANISMS,	73	68	773

Water Supply of Hudson.

Chemical Examination of Water from Gates Pond, in Berlin.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4832	June 13	June 14	Slight.	Slight.	0.00	–	–	.0000	.0164	.0146	.0018	–	.0030	.0006	–
4932	July 10	July 11	V. sl't.	V. sl't.	0.10	–	–	.0000	.0214	.0170	.0044	–	.0000	.0001	–
5081	Aug. 20	Aug. 21	Slight.	Slight.	0.05	–	–	.0016	.0200	.0168	.0032	–	.0090	.0000	–
5164	Sept. 11	Sept. 11	Slight.	Slight.	0.02	–	–	.0000	.0192	.0134	.0058	–	.0050	.0001	–
5234	Oct. 8	Oct. 9	Slight.	Slight.	0.00	–	–	.0008	.0280	.0102	.0178	–	.0030	.0000	–
5337	Nov. 12	Nov. 13	Slight.	Cons.	0.10	–	–	.0088	.0370	.0340	.0030	–	.0030	.0000	–
5353	Nov. 18	Nov. 19	Slight.	Cons.	0.05	–	–	.0066	.0170	.0132	.0038	–	.0050	.0001	–
5431	Dec. 10	Dec. 11	Slight.	Cons.	0.00	–	–	.0080	.0188	.0146	.0042	–	.0030	.0000	–
	1890.														
5566	Jan. 24	Jan. 25	Slight.	Slight.	0.00	–	–	.0062	.0166	.0122	.0044	–	.0060	.0001	–
5676	Feb. 14	Feb. 15	V. sl't.	V. sl't.	0.00	–	–	.0042	.0086	.0080	.0006	–	.0070	.0000	–
5761	Mar. 10	Mar. 11	V. sl't.	V. sl't.	0.03	–	–	.0050	.0116	.0094	.0022	.22	.0030	.0000	–
5877	Apr. 10	Apr. 11	Slight.	Slight.	0.00	–	–	.0036	.0132	.0088	.0044	.21	.0060	.0000	–
5967	May 13	May 14	Slight.	Cons.	0.00	–	–	.0028	.0150	.0122	.0028	.21	.0020	.0001	–
6071	June 16	June 18	Slight.	V. sl't.	0.00	–	–	.0002	.0168	.0124	.0044	.19	.0030	.0000	–
6227	July 15	July 15	Slight.	Slight.	0.02	2.95	–	.0002	.0180	.0132	.0048	.19	.0010	.0001	1.1
6418	Aug. 19	Aug. 19	V. sl't.	Slight.	0.00	3.25	1.40	.0000	.0174	.0142	.0032	.24	.0040	.0000	1.4
6490	Sept. 10	Sept. 10	Slight.	Slight.	0.03	2.50	0.60	.0000	.0170	.0140	.0030	.21	.0140	.0000	1.4
6579	Oct. 9	Oct. 10	Slight.	Slight.	0.10	2.40	0.85	.0008	.0166	.0134	.0032	.19	.0080	.0001	1.1
6702	Nov. 10	Nov. 11	Slight.	Cons.	0.00	2.55	1.00	.0014	.0182	.0112	.0070	.22	.0030	.0000	1.1
6813	Dec. 11	Dec. 11	Slight.	V. sl't.	0.02	3.40	1.35	.0028	.0236	.0198	.0038	.23	.0080	.0000	1.4
Av.	....	....	....	....	0.02	2.82	1.04	.0023	.0175	.0131	.0044	.21	.0049	.0001	1.2

Odor, generally none, occasionally vegetable; when heated, often disagreeable.——The samples were collected from the pond.

HUDSON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.								1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Nov.	Dec.	Jan.	Feb.
Day of examination,	14	11	22	12	10	14	19	11	28	15
Number of sample,	4832	4932	5081	5164	5234	5337	5353	5431	5566	5676
PLANTS.										
Diatomaceæ,	**pr.**	**10**	**69**	**25**	**149**	**383**	**777**	**2,068**	**1,817**	**410**
Asterionella,	pr.	0	66	3	6	114	464	1,756	1,730	407
Melosira,	pr.	0	0	7	107	120	160	44	3	0
Synedra,	0	1	pr.	2	1	15	27	0	0	0
Tabellaria,	0	9	3	13	35	134	126	268	84	3
Cyanophyceæ,	**4**	**9**	**5**	**4**	**7**	**3**	**5**	**0**	**240**	**12**
Anabæna,	4	0	4	pr.	0	2	0	0	0	0
Aphanocapsa,	0	0	0	0	3	0	0	0	222	12
Clathrocystis,	0	pr.	1	4	4	1	5	0	0	0
Chroöcoccus,	0	9	0	0	0	0	0	0	18	0
Microcystis,	0	0	0	0	0	0	0	0	0	0
Algæ,	**35**	**3**	**22**	**12**	**11**	**24**	**30**	**1**	**4**	**0**
Arthrodesmus,	0	0	0	0	pr.	9	4	0	0	0
Chlorococcus,	35	3	22	3	4	13	23	0	4	0
Glœocystis,	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	3	2	0	0	0	0	0
Spirotænia,	0	0	0	0	0	0	0	0	0	0
Staurastrum,	0	0	pr.	3	0	0	3	0	0	0
Zoöspores,	0	0	0	3	5	2	0	1	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**4**	**22**	**20**	**29**	**9**	**9**	**36**	**48**	**5**
Ceratium,	0	0	0	0	0	0	0	0	0	0
Ciliated infusorian,	0	1	pr.	0	1	0	1	0	0	0
Dinobryon,	pr.	0	7	9	24	5	7	34	48	5
Monas,	0	2	0	0	pr.	0	1	0	0	0
Peridinium,	pr.	1	15	9	1	1	0	2	pr.	pr.
Trachelomonas,	0	0	0	2	3	3	0	0	0	0
Vermes,	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**
Anurea,	0	0	0	0	0	0	0	0	0	0
Polyarthra,	0	0	0	1	0	0	0	0	0	0
Rotatorian ova,	0	0	1	0	0	0	0	1	0	0
Crustacea,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cyclops,	0	pr.	0	0	0	0	0	0	0	0
Daphnia,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	39	26	119	62	196	419	821	2,106	2,109	427

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	12	15	14	18	16	20	10	11	11	12
Number of sample,	5761	5877	5967	6071	6227	6418	6490	6579	6702	6813
PLANTS.										
Diatomaceæ,	**0**	**1,129**	**13**	**102**	**41**	**328**	**9**	**61**	**595**	**38**
Asterionella,	0	1,093	4	45	0	11	0	54	114	2
Melosira,	0	28	5	23	2	3	4	7	448	0
Synedra,	0	pr.	2	8	11	140	1	0	21	36
Tabellaria,	0	8	2	26	28	174	4	0	12	0
Cyanophyceæ,	**0**	**0**	**1**	**40**	**1**	**50**	**53**	**34**	**144**	**0**
Anabæna,	0	0	1	33	pr.	0	0	0	0	0
Aphanocapsa,	0	0	0	0	0	10	0	0	0	0
Clathrocystis,	0	0	pr.	7	1	0	29	0	4	0
Chroöcoccus,	0	0	0	0	0	40	24	34	62	0
Microcystis,	0	0	0	0	0	0	0	0	78	0
Algæ,	**0**	**9**	**227**	**14**	**15**	**31**	**0**	**58**	**8**	**0**
Arthrodesmus,	0	0	pr.	4	0	1	0	0	pr.	0
Chlorococcus,	0	9	159	10	6	19	0	38	7	0
Glœocystis,	0	0	0	0	0	0	0	12	0	0
Raphidium,	0	0	0	0	7	2	0	8	0	0
Spirotænia,	0	0	66	0	0	0	0	0	0	0
Staurastrum,	0	0	2	0	2	9	0	0	1	0
Zoöspores,	0	0	0	0	0	0	0	0	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Infusoria,	**54**	**31**	**3**	**2**	**14**	**50**	**0**	**77**	**710**	**178**
Ceratium,	0	0	0	0	0	17	0	0	0	0
Ciliated infusorian,	0	0	0	0	0	0	0	0	0	0
Dinobryon,	53	31	2	0	0	11	0	76	708	178
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	1	pr.	1	0	14	17	0	1	0	0
Trachelomonas,	pr.	0	0	2	pr.	5	0	0	2	0
Vermes,	**0**	**0**	**0**	**2**	**1**	**1**	**0**	**0**	**1**	**pr.**
Anurea,	0	0	0	0	0	1	0	0	1	pr.
Polyarthra,	0	0	0	1	1	0	0	0	0	0
Rotatorian ova,	0	0	0	1	0	0	0	0	0	0
Crustacea,	**pr.**	**0**	**pr.**	**pr.**	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**
Cyclops,	pr.	0	pr.	pr.	pr.	pr.	pr.	0	0	0
Daphnia,	0	0	0	0	0	pr.	0	0	0	0
TOTAL ORGANISMS,	54	1,169	244	160	72	460	63	231	1,458	216

HYDE PARK.

WATER SUPPLY OF HYDE PARK. — HYDE PARK WATER COMPANY.

Chemical Examination of Water from the Tubular Wells of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
5604	Feb. 7	Feb. 7	None.	None.	0.00	–	.0002	.0004	–	.0600	.0001	–
6371	Aug. 6	Aug. 7	None.	Very slight.	0.03	9.35	.0010	.0042	.88	.0500	.0003	4.2

Odor, none. —— The samples were collected from a faucet in the pumping-station, while pumping.

Microscopical Examination.

No. 5604. Fungi, *Leptothrix*, pr. No. 6371. No organisms.

Chemical Examination of Water from the Distributing Reservoir of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
5605	Feb. 7	Feb. 8	Dist't.	V. sl't.	0.0	–	–	.0004	.0126	.0024	.0102	–	.0520	.0002	–
5606	Feb. 7	Feb. 8	Dist't.	V. sl't.	0.0	–	–	.0002	.0138	.0022	.0116	–	.0520	.0001	–
6372	Aug. 6	Aug. 7	V. sl't.	V. sl't.	0.0	8.05	2.10	.0010	.0138	.0108	.0030	.72	.0150	.0002	3.9

Odor, Nos. 5605 and 5606, none; No. 6372, disagreeable. —— The samples were collected from the reservoir; samples numbered 5605 and 6372 at the surface, and 5606 eight feet below the surface. For analyses of the water of the reservoir and in the gate-house in the summer of 1889, see Part I. of special report on Water Supply and Sewerage, 1890, p. 731.

HYDE PARK.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	Feb.	Feb.	Aug.
Day of examination,	8	8	8
Number of sample,	5605	5606	6372
PLANTS.			
Diatomaceæ,	**351**	**295**	**157**
Asterionella,	351	295	153
Stephanodiscus,	0	0	2
Synedra,	pr.	0	2
Algæ,	**338**	**311**	**9**
Chlorococcus,	0	0	4
Cœlastrum,	0	0	2
Gonium,	338	311	0
Raphidium,	0	0	3
ANIMALS.			
Infusoria,	**6**	**2**	**12**
Peridinium,	0	0	12
Uvella (col.),	6	2	0
Vermes. Anurea,	**0**	**0**	**4**
TOTAL ORGANISMS,	695	608	182

IPSWICH.

Chemical Examination of Water from Streams near Ipswich.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
5470	Dec. 20	Dec. 23	Slight.	Slight.	0.15	3.30	1.10	.0008	.0080	.0048	.0032	.48	.0070	.0002	1.1
5471	Dec. 20	Dec. 23	None.	Slight.	1.10	4.95	2.45	.0010	.0198	.0176	.0022	.40	.0120	.0000	1.6
5472	Dec. 20	Dec. 23	V. sl't.	Slight.	0.70	4.90	2.05	.0006	.0186	.0160	.0026	.42	.0080	.0000	1.5
	1890.														
5499	Jan. 1	Jan. 4	V. sl't.	V. sl't.	0.50	6.10	1.75	.0000	.0210	–	–	.74	.0080	.0001	1.7
5514	Jan. 8	Jan. 9	V. sl't.	V. sl't.	0.70	5.40	2.05	.0006	.0170	.0168	.0002	.73	.0150	.0001	1.7

No. 5470. Odor, none.——The sample was collected from Dow's Brook at the crossing of the old road to Dow's Corner. No. 5471. Odor, none. The sample was collected from Egypt River, just above the road from Ipswich to Newburyport. No. 5472. Odor, very faintly vegetable. The sample was collected from the river, just above the town where the eastern division of the Boston and Maine Railroad runs along the bank of the river. No. 5499. Odor, none. The sample was collected from Miles River, just above its confluence with the Ipswich River. No. 5514. Odor, very faintly vegetable. The sample was collected from the same place as No. 5499.

IPSWICH.

Microscopical Examination.

No. 5470. Diatomaceæ, *Ceratoneis*, pr.; *Meridion*, 3; *Navicula*, pr.; *Synedra*, pr.; *Tabellaria*, 1. Fungi, *Crenothrix*, 2. Total organisms, 6.

No. 5471. Diatomaceæ, *Ceratoneis*, pr.; *Meridion*, pr.; *Synedra*, pr. Algæ, *Chlorococcus*, pr.

No. 5472. Diatomaceæ, *Ceratoneis*, 2; *Meridion*, pr.; *Navicula*, pr.; *Synedra*, pr.; *Tabellaria*, 1. Infusoria, *Dinobryon*, 10; *Monas*, pr. Total organisms, 13.

No. 5499. Diatomaceæ, *Ceratoneis*, pr.; *Meridion*, 1; *Synedra*, 2. Fungi, *Crenothrix*, 1. Total organisms, 4.

No. 5514. Diatomaceæ, *Ceratoneis*, 2; *Synedra*, 5. Algæ, *Conferva*, pr. Fungi, *Crenothrix*, pr. Infusoria, *Dinobryon*, 4; *Peridinium*, pr. Total organisms, 11.

KINGSTON.

Chemical Examination of Water from Jones River.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
5700	Feb. 24	Feb. 24	V. sl't.	V. sl't.	0.6	4.20	1.50	.0008	.0144	.0126	.0018	.64	.0120	.0001	1.1

Odor, faintly vegetable.—The sample was collected from the river, near the pumping-station of the Kingston Water Works.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 30; *Ceratoneis*, pr.; *Cocconeis*, pr.; *Melosira*, 25; *Meridion*, pr.; *Synedra*, pr.; *Tabellaria*, 3. Cyanophyceæ, *Nostoc*, pr. Algæ, *Conferva*, 15; *Zoöspores*, pr. Fungi, *Crenothrix*, 2. Infusoria, *Peridinium*, pr. Crustacea, *Daphnia*, pr. Total organisms, 75.

Chemical Examination of Water from a Flowing Well.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
5701	Feb. 24	Feb. 24	None.	None.	0.0	3.95	0.70	.0026	.0028	–	–	.70	.0100	.0000	1.9

Odor, none.—The sample was collected from the well, which is 10½ feet in depth.

Microscopical Examination.

Diatomaceæ, *Tabellaria*, 2. Infusoria, *Peridinium*, pr.

WATER SUPPLY OF LAWRENCE.

Chemical Examination of Water from the Merrimack River at the Intake of the Lawrence Water Works, collected one foot beneath the surface.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4850	June 19	June 20	Dist't.	Cons., e'thy & floc't.	0.20	–	–	.0020	.0226	.0186	.0040	–	.0060	.0003	–
4952	July 17	July 18	Slight.	Cons.	0.30	–	–	.0072	.0200	.0174	.0026	.18	.0080	.0004	–
5061	Aug. 14	Aug. 15	Slight.	Slight.	0.35	–	–	.0044	.0236	.0188	.0048	.18	.0000	.0002	–
5171	Sept. 11	Sept. 12	V. sl't.	Slight, earthy.	0.30	–	–	.0098	.0214	.0178	.0036	.24	.0070	.0002	–
5258	Oct. 15	Oct. 16	Slight.	Slight.	0.50	–	–	.0024	.0186	.0164	.0022	.20	.0050	.0001	–
5364	Nov. 19	Nov. 20	V. sl't.	V. sl't.	0.45	–	–	.0022	.0208	.0168	.0040	.22	.0060	.0001	–
5464	Dec. 18	Dec. 19	V. sl't.	Cons., e'thy & floc't.	0.30	–	–	.0020	.0138	.0108	.0030	.19	.0150	.0001	–
	1890.														
5664	Feb. 13	Feb. 14	Slight.	Slight.	0.30	–	–	.0000	.0118	.0098	.0020	.16	.0150	.0000	–
5887	Apr. 15	Apr. 16	Dist't.	Heavy, e'thy & floc't.	0.25	–	–	.0010	.0120	.0096	.0024	.10	.0080	.0001	–
5972	May 14	May 15	Slight.	Cons., earthy.	0.30	–	–	.0034	.0138	.0120	.0018	.10	.0050	.0000	–
6100	June 18	June 19	Slight.	Cons., earthy.	0.40	–	–	.0040	.0172	.0136	.0036	.15	.0050	.0001	–
6235	July 15	July 16	V. sl't.	Slight.	0.25	4.10	–	.0058	.0202	.0146	.0056	.20	.0050	.0003	1.3
6424	Aug. 19	Aug. 20	V. sl't.	Slight, floc't.	0.20	4.20	2.10	.0160	.0216	.0158	.0058	.27	.0050	.0002	1.7
6492	Sept. 10	Sept. 11	Slight.	Cons.	0.35	4.80	1.45	.0058	.0182	.0162	.0020	.20	.0150	.0003	2.1
6523	Sept. 17	Sept. 18	Dec'd.	Cons., earthy.	0.90	–	–	.0020	.0246	.0192	.0054	.14	.0050	.0000	–
6602	Oct. 15	Oct. 16	V. sl't.	Slight.	0.30	4.65	1.35	.0046	.0188	.0152	.0036	.15	.0080	.0002	1.4
6717	Nov. 12	Nov. 12	V. sl't.	V. sl't.	0.45	3.60	1.35	.0026	.0130	.0118	.0012	.20	.0080	.0002	1.6
6832	Dec. 16	Dec. 17	Slight.	Slight.	0.20	3.70	1.15	.0044	.0158	.0122	.0036	.18	.0200	.0001	1.6
Av.	....	....	....	....	0.33	4.19	1.48	.0045	.0180	.0146	.0034	.18	.0080	.0002	1.6

Odor, generally faintly vegetable, frequently mouldy, occasionally none. —— The samples were collected from the middle of the river, opposite the pumping-station of the Lawrence Water Works.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.
Day of examination, ...	20	18	15	12	17	21	23	15
Number of sample, ...	4850	4952	5061	5171	5258	5364	5464	5664
PLANTS.								
Diatomaceæ, ...	**6**	**9**	**5**	**9**	**1**	**29**	**0**	**9**
Asterionella, ...	pr.	0	4	0	0	3	pr.	1
Melosira, ...	1	2	0	0	0	12	0	5
Synedra, ...	4	5	1	5	1	pr.	0	3
Tabellaria, ...	1	2	pr.	4	0	4	pr.	0

LAWRENCE.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	0	0	0
Algæ,	pr.	9	6	9	0	0	0	0
Chlorococcus,	pr.	9	6	9	0	0	0	0
Scenedesmus,	pr.	0	0	0	0	0	0	0
Fungi. Crenothrix,	pr.	0	12	8	5	0	7	pr.
ANIMALS.								
Infusoria,	0	32	pr.	18	0	0	0	2
Dinobryon,	0	32	pr.	17	0	0	0	2
Peridinium,	0	pr.	0	0	0	0	0	0
Trachelomonas,	0	pr.	0	1	0	0	0	0
TOTAL ORGANISMS,	6	50	23	44	6	29	7	11

	1890.									
	April.	May.	June.	July.	Aug.	Sept.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	16	25	16	22	11	18	17	13	18
Number of sample,	5887	5972	6100	6235	6424	6492	6523	6602	6717	6832
PLANTS.										
Diatomaceæ,	14	6	29	30	24	4	0	19	5	7
Asterionella,	1	0	2	15	4	0	0	8	0	0
Melosira,	8	0	13	1	19	0	0	10	5	5
Synedra,	5	6	14	14	1	1	0	1	pr.	2
Tabellaria,	0	0	0	0	0	3	0	0	0	0
Cyanophyceæ. Chroöcoccus,	0	0	0	0	56	0	0	0	0	0
Algæ,	0	pr.	11	234	28	0	0	0	0	0
Chlorococcus,	0	pr.	10	233	19	0	0	0	0	0
Scenedesmus,	0	0	1	1	9	0	0	0	0	0
Fungi. Crenothrix,	1	pr.	4	14	2	15	8	52	0	0
ANIMALS.										
Infusoria,	1	2	1	32	3	0	2	0	pr.	0
Dinobryon,	0	2	0	31	2	0	0	0	0	0
Peridinium,	1	0	1	1	1	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	2	0	pr.	0
TOTAL ORGANISMS,	16	8	45	310	113	19	10	71	5	7

LAWRENCE.

Chemical Examination of Water from the Force Main at the Pumping-station of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1889.														
4851	June 19	June 20	Slight.	Slight.	0.20	–	–	.0024	.0182	.0156	.0026	–	.0120	.0002	–
4953	July 17	July 18	Dist't.	Cons.	0.25	–	–	.0078	.0210	.0180	.0030	.17	.0120	.0003	–
5063	Aug. 14	Aug. 15	Slight.	Cons., e'thy & floc't.	0.35	–	–	.0038	.0220	.0194	.0026	.19	.0070	.0003	–
5173	Sept. 11	Sept. 12	Slight.	Slight, earthy.	0.20	–	–	.0070	.0200	.0168	.0032	.28	.0120	.0002	–
5259	Oct. 15	Oct. 16	Dist't.	Cons., e'thy & floc't.	0.65	–	–	.0018	.0208	.0176	.0032	.20	.0080	.0002	–
5365	Nov. 19	Nov. 20	V. sl't.	V. sl't.	0.40	–	–	.0018	.0188	.0174	.0014	.22	.0120	.0002	–
5465	Dec. 18	Dec. 19	V. sl't.	Slight, e'thy & floc't.	0.30	–	–	.0016	.0136	.0112	.0024	.16	.0120	.0001	–
	1890.														
5534	Jan. 15	Jan. 16	Slight, milky, clayey.	Slight, earthy.	0.25	–	–	.0014	.0150	.0110	.0040	.20	.0220	.0000	–
5665	Feb. 13	Feb. 14	Slight, milky.	Slight.	0.20	–	–	.0000	.0108	.0084	.0024	.18	.0130	.0001	–
5783	Mar. 12	Mar. 13	Slight, milky.	Heavy, floc't.	0.35	–	–	.0002	.0104	.0080	.0024	.18	.0090	.0002	–
5888	Apr. 15	Apr. 16	Dist't.	Heavy, e'thy & floc't.	0.20	–	–	.0002	.0142	.0086	.0056	.12	.0100	.0000	–
5973	May 14	May 15	Slight, milky.	Cons., earthy.	0.30	–	–	.0030	.0152	.0116	.0036	.12	.0080	.0000	–
6101	June 18	June 19	Slight.	Cons., earthy.	0.45	–	–	.0020	.0134	.0134	.0000	.15	.0200	.0002	1.3
6236	July 15	July 16	Slight.	Cons., e'thy & floc't.	0.20	3.70	–	.0070	.0224	.0148	.0076	.21	.0100	.0003	1.1
6426	Aug. 19	Aug. 20	V. sl't.	Cons., floc't.	0.20	4.20	2.60	.0124	.0218	.0174	.0044	.28	.0080	.0004	1.7
6524	Sept. 17	Sept. 18	Dist't.	Cons., earthy.	0.90	–	–	.0030	.0254	.0190	.0064	.13	.0070	.0001	–
6604	Oct. 15	Oct. 16	V. sl't.	Slight.	0.32	4.90	1.15	.0026	.0162	.0142	.0020	.17	.0120	.0002	1.5
6719	Nov. 12	Nov. 12	V. sl't.	Slight.	0.45	3.90	1.10	.0022	.0134	.0122	.0012	.19	.0100	.0002	1.5
6834	Dec. 16	Dec. 17	Slight.	Slight.	0.20	3.10	1.20	.0020	.0158	.0120	.0038	.18	.0220	.0002	1.5
Av.	....	....	....	....	0.34	4.02	1.51	.0033	.0173	.0140	.0033	.18	.0119	.0002	1.4

Odor, generally faintly vegetable, frequently mouldy, occasionally none.——The samples were collected from a faucet in the check-valve, just beyond the pump, and represent a mixture of water from the river and the filter-gallery, though but a small part of the water comes from the latter source.

LAWRENCE.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	20	18	15	12	17	21	23	18	15	15
Number of sample,	4851	4953	5063	5173	5259	5365	5465	5534	5665	5783
PLANTS.										
Diatomaceæ,	0	9	5	6	2	8	10	9	7	13
Asterionella,	0	0	0	0	0	2	10	1	pr.	0
Melosira,	0	0	0	0	0	4	0	5	4	12
Navicula,	0	pr.	0	pr.	0	0	0	pr.	0	0
Synedra,	0	3	3	4	2	2	0	3	3	1
Tabellaria,	0	6	2	2	0	0	0	0	0	0
Algæ,	10	12	3	0	0	0	0	0	0	0
Chlorococcus,	10	12	3	0	0	0	0	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0	0
Fungi,	2	0	26	13	12	0	1	14	1	3
Crenothrix,	0	0	26	11	12	0	1	8	1	3
Leptothrix,	2	0	0	2	0	0	0	6	0	0
ANIMALS.										
Infusoria. Dinobryon,	0	0	3	pr.	0	0	0	0	0	1
Porifera. Sponge spicules,	0	0	0	0	pr.	0	0	0	0	0
TOTAL ORGANISMS,	12	21	37	19	14	8	11	23	8	17

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	16	24	16	22	18	17	12	18
Number of sample,	5888	5973	6101	6236	6426	6524	6604	6719	6834
PLANTS.									
Diatomaceæ,	9	12	29	48	42	4	pr.	8	8
Asterionella,	1	0	1	3	5	0	0	4	3
Melosira,	4	4	13	2	9	0	0	1	5
Navicula,	0	pr.	2	2	3	4	pr.	2	0
Synedra,	4	6	8	34	18	0	0	1	pr.
Tabellaria,	0	2	5	7	7	0	0	0	0
Algæ,	0	0	5	1	37	0	0	0	0
Chlorococcus,	0	0	5	0	12	0	0	0	0
Staurogenia,	0	0	0	1	25	0	0	0	0
Fungi,	3	2	1	2	4	14	6	1	2
Crenothrix,	3	2	1	2	4	14	6	1	2
Leptothrix,	0	0	0	0	0	0	0	0	0
ANIMALS.									
Infusoria. Dinobryon,	0	0	0	0	6	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	12	14	35	51	89	18	6	9	10

LAWRENCE.

Chemical Examination of Water from the Distributing Reservoir of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4852	June 19	June 20	Dist't.	Cons., e'thy & floc't.	0.20	–	–	.0024	.0194	.0186	.0008	–	.0120	.0002	–
4954	July 17	July 18	Slight.	Slight.	0.20	–	–	.0074	.0196	.0166	.0030	.17	.0180	.0004	–
5062	Aug. 14	Aug. 15	V. sl't.	Slight.	0.30	–	–	.0064	.0196	.0174	.0022	.14	.0090	.0003	–
5172	Sept. 11	Sept. 12	V. sl't.	V. sl't.	0.30	–	–	.0106	.0200	.0176	.0024	.24	.0150	.0003	–
5260	Oct. 15	Oct. 16	V. sl't.	Slight.	0.45	–	–	.0016	.0152	.0128	.0024	.21	.0100	.0001	–
5366	Nov. 19	Nov. 20	V. sl't.	V. sl't.	0.45	–	–	.0004	.0152	.0124	.0028	.22	.0130	.0001	–
5466	Dec. 18	Dec. 19	V. sl't.	Slight, earthy.	0.25	–	–	.0014	.0120	.0100	.0020	.18	.0150	.0001	–
	1890.														
5535	Jan. 15	Jan. 16	Slight.	V. sl't.	0.25	–	–	.0004	.0102	.0080	.0022	.18	.0220	.0001	–
5666	Feb. 13	Feb. 14	Slight.	Slight.	0.20	–	–	.0004	.0106	.0078	.0028	.18	.0150	.0000	–
5782	Mar. 12	Mar. 13	V. sl't.	Slight, earthy.	0.35	–	–	.0006	.0102	.0062	.0040	.16	.0110	.0001	–
5889	Apr. 15	Apr. 16	V. sl't.	Slight.	0.20	–	–	.0014	.0094	.0082	.0012	.15	.0150	.0000	–
5974	May 14	May 15	Slight.	Slight, earthy.	0.20	–	–	.0020	.0128	.0100	.0028	.12	.0100	.0001	–
6102	June 18	June 19	V. sl't.	Slight.	0.30	–	–	.0024	.0118	.0112	.0006	.14	.0200	.0003	–
6237	July 15	July 16	None.	V. sl't.	0.22	3.35	–	.0058	.0132	.0120	.0012	.19	.0125	.0002	1.4
6425	Aug. 19	Aug. 20	None.	Slight, floc't.	0.20	3.70	1.05	.0078	.0146	.0132	.0014	.26	.0108	.0003	1.7
6494	Sept. 10	Sept. 11	V. sl't.	Slight.	0.30	3.75	1.35	.0070	.0168	.0136	.0032	.19	.0300	.0003	2.1
6525	Sept. 17	Sept. 18	Slight.	Slight.	0.30	–	–	.0068	.0186	.0140	.0046	.15	.0080	.0001	3.1
6603	Oct. 15	Oct. 16	V. sl't.	V. sl't.	0.28	3.80	1.10	.0030	.0194	.0128	.0066	.16	.0100	.0002	1.4
6718	Nov. 12	Nov. 12	V. sl't.	Slight.	0.45	3.75	1.10	.0014	.0136	.0114	.0022	.18	.0090	.0002	1.7
6833	Dec. 16	Dec. 17	Slight.	Slight.	0.23	3.20	0.85	.0024	.0136	.0118	.0018	.18	.0220	.0001	1.7
Av.	....	....	....	....	0.28	3.64	1.09	.0034	.0146	.0122	.0024	.18	.0141	.0002	1.6

Odor, generally faintly vegetable, frequently none, occasionally mouldy.——The samples were collected from a faucet in the gate-house and represent water flowing out of the reservoir.

LAWRENCE.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	20	18	15	12	17	21	23	18	15	15
Number of sample,	4852	4954	5062	5172	5260	5366	5466	5535	5666	5782
PLANTS.										
Diatomaceæ,	3	4	7	2	3	2	4	9	7	4
Asterionella,	0	0	0	0	0	0	0	2	0	1
Fragillaria,	0	0	0	0	0	0	0	0	pr.	0
Melosira,	1	3	3	0	3	0	2	5	5	3
Synedra,	pr.	0	0	0	pr.	2	pr.	2	2	pr.
Tabellaria,	2	1	4	2	0	pr.	2	0	pr.	0
Cyanophyceæ,	0	6	pr.	0	0	0	0	0	0	0
Anabæna,	0	0	pr.	0	0	0	0	0	0	0
Chroöcoccus,	0	6	0	0	0	0	0	0	0	0
Nostoc,	0	0	0	0	0	0	0	0	0	0
Rivularia,	0	0	0	0	0	0	0	0	0	0
Algæ,	2	20	50	33	17	0	0	0	0	0
Chlorococcus,	2	17	5	33	9	0	0	0	0	0
Cœlastrum,	0	3	0	0	0	0	0	0	0	0
Eudorina,	0	0	0	0	0	0	0	0	0	0
Pleurococcus,	0	0	45	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	8	0	0	0	0	0
Fungi. Crenothrix,	2	0	2	4	2	0	35	pr.	0	0
ANIMALS.										
Infusoria,	0	0	0	3	0	3	pr.	pr.	pr.	0
Dinobryon,	0	0	0	0	0	3	pr.	pr.	0	0
Peridinium,	0	0	0	3	0	pr.	0	0	pr.	0
Trachelomonas,	0	0	0	0	0	0	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	7	30	59	42	22	5	39	9	7	4

LAWRENCE.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	April.	May.	June.	July.	Aug.	Sept.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	16	24	16	22	11	18	17	13	18
Number of sample,	5889	5974	6102	6237	6425	6494	6525	6603	6718	6833
PLANTS.										
Diatomaceæ,	**27**	**6**	**14**	**2**	**4**	**1**	**0**	**18**	**38**	**25**
Asterionella,	5	0	9	0	0	0	0	1	22	12
Fragillaria,	0	0	0	0	0	0	0	11	0	0
Melosira,	11	3	0	0	2	0	0	0	7	3
Synedra,	11	3	5	2	2	1	0	2	9	10
Tabellaria,	0	0	0	0	0	0	0	4	0	0
Cyanophyceæ,	**0**	**0**	**0**	**0**	**0**	**40**	**0**	**72**	**22**	**10**
Anabæna,	0	0	0	0	0	21	0	58	0	0
Chroöcoccus,	0	0	0	0	0	19	0	14	0	0
Nostoc,	0	0	0	0	0	0	0	0	22	0
Rivularia,	0	0	0	0	0	0	0	0	0	10
Algæ,	**0**	**0**	**0**	**195**	**37**	**13**	**0**	**pr.**	**0**	**0**
Chlorococcus,	0	0	0	159	31	0	0	pr.	0	0
Cœlastrum,	0	0	0	25	5	0	0	0	0	0
Eudorina,	0	0	0	0	0	13	0	0	0	0
Pleurococcus,	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	11	1	0	0	0	0	0
Fungi. Crenothrix,	**0**	**1**	**5**	**2**	**5**	**2**	**12**	**0**	**pr.**	**1**
ANIMALS.										
Infusoria,	**0**	**pr.**	**0**	**3**	**0**	**1**	**4**	**pr.**	**0**	**1**
Dinobryon,	0	0	0	2	0	0	0	0	0	pr.
Peridinium,	0	pr.	0	0	0	0	4	pr.	0	0
Trachelomonas,	0	0	0	1	0	1	0	pr.	0	1
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**
TOTAL ORGANISMS,	27	7	19	202	46	57	16	90	60	37

LAWRENCE.

Chemical Examination of Water from a Faucet at the Lawrence Experiment Station, supplied from the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of		Temperature, F°.	Appearance.			Odor.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Dissolved Oxygen.	Oxygen required for Saturation.	Bacteria in one Cubic Centimeter.
	Collection.	Examination.		Turbidity.	Sediment.	Color.		Total.	Loss on Ignition.	Free.	Albuminoid.		Nitrates.	Nitrites.				
	1889.																	
2872	June 4	June 4	-	Very slight.	Very slight.	.20	Faint.	3.52	1.20	.0006	.0100	.17	.0150	.0001	-	-	-	7
2910	11	11	-	Very slight.	Very slight.	.20	Decided.	4.08	1.60	.0010	.0120	.14	.0200	.0001	-	-	-	55
2941	18	18	-	Very slight.	Very slight.	.20	-	4.80	1.92	.0010	.0152	.16	.0170	.0000	-	-	-	152
2982	25	25	-	Very slight.	Very slight.	.25	Slight.	3.96	1.52	.0002	.0154	.16	.0150	.0000	-	-	-	53
3015	July 2	July 2	-	-	-	-	-	4.08	1.40	.0020	.0154	.17	.0150	.0000	-	-	-	69
3046	9	9	-	Very slight.	Very slight.	.00	-	3.96	1.24	.0008	.0142	.18	.0200	.0000	-	-	-	-
3087	16	16	-	Very slight.	None.	.30	-	3.80	1.12	.0014	.0150	.18	.0150	.0000	-	-	-	195
3120	23	23	-	Very slight.	None.	.20	-	3.96	1.08	.0006	.0110	.21	.0150	.0000	-	-	-	44
3157	30	30	-	Very slight.	Very slight.	.20	-	4.60	1.52	.0006	.0112	.20	.0150	.0000	-	-	-	41
3191	Aug. 6	Aug. 6	-	None.	None.	.20	Faint.	4.20	1.48	.0006	.0120	.20	.0200	.0000	-	-	-	12
3226	13	13	-	Decided.	Much, red.	.50	Faint.	8.36	2.24	.0012	.0260	.18	.0150	.0000	-	-	-	27
3272	20	20	67	None.	None.	.20	Faint.	5.55	2.20	.0002	.0114	.20	.0200	.0000	-	.51	.90	16
3306	27	27	67	None.	None.	.30	Faint.	-	-	.0006	.0140	.19	.0220	.0000	-	.49	.90	56
3336	Sept. 3	Sept. 3	68	None.	None.	.30	None.	5.04	1.52	.0016	.0142	.23	.0190	.0000	-	.44	.90	42
3386	10	10	69	None.	None.	.20	None.	5.28	1.88	.0018	.0128	.25	.0180	.0002	-	.48	.88	109
3420	17	17	68	None.	None.	.40	Slight.	4.60	1.30	.0008	.0138	.26	.0200	.0000	-	.55	.90	113

3461	24	24	66	None.	None.	.20	Faint.	4.10	1.00	.0016	.0148	.25	.0150	.0000	-	.64	.92	99
3495	30	30	63	None.	None.	.30	Slight.	4.60	0.80	.0016	.0152	.23	.0100	.0000	-	.68	.96	128
3538	Oct. 7	Oct. 7	60	None.	None.	.30	Slight.	4.50	1.40	.0012	.0148	.22	.0160	.0001	-	.72	.98	170
3589	14	14	57	None.	None.	.30	Slight.	5.70	2.10	.0015	.0150	.20	.0100	.0000	-	.86	1.02	46
3627	21	21	54	None.	None.	.30	Slight.	4.70	2.10	.0022	.0150	.21	.0080	.0000	-	.90	1.06	152
3658	28	28	54	None.	None.	.30	None.	4.90	2.10	.0010	.0154	.21	.0100	.0000	-	.87	1.06	-
3703	Nov. 4	Nov. 4	53	None.	None.	.30	None.	-	-	.0008	.0156	.22	.0140	.0000	-	.89	1.08	43
3739	11	11	52	None.	Slight.	.40	Slight.	4.00	1.20	.0014	.0136	.21	.0060	.0000	-	.97	1.08	-
3757	18	18	50	None.	None.	.30	None.	3.90	1.70	.0010	.0144	.21	.0100	.0000	-	1.01	1.12	91
3784	25	25	48	None.	None.	.30	None.	4.10	1.20	.0010	.0140	.22	.0090	.0000	-	1.06	1.14	375
3820	Dec. 2	Dec. 2	46	None.	None.	.30	None.	4.10	1.50	.0010	.0126	.20	.0100	.0000	-	1.16	1.17	82
3849	9	9	45	None.	None.	.30	None.	4.60	2.30	.0016	.0138	.18	.0160	.0000	-	1.21	1.19	21
3893	16	16	43	Very slight.	Slight.	-	Slight.	3.70	1.30	.0008	.0114	.18	.0110	.0000	-	1.25	1.22	95
3923	23	23	43	None.	None.	.40	None.	-	-	.0010	.0124	.17	.0170	.0000	-	1.21	1.21	-
3968	30	30	41	Very slight.	None.	.30	None.	4.40	1.20	.0020	.0134	.18	.0080	.0000	-	1.28	1.24	43
	1890.																	
4003	Jan. 6	Jan. 6	40	Very slight.	None.	.30	Slight.	3.90	1.20	.0008	.0102	.18	.0100	.0000	-	1.30	1.25	25
4031	13	13	41	Very slight.	None.	.30	Slight.	3.80	1.40	.0014	.0112	.18	.0100	.0000	-	1.29	1.24	32
4063	20	20	41	Slight.	None.	.40	Slight.	3.60	1.00	.0014	.0114	.19	.0140	.0000	-	1.40	1.24	82
4080	27	27	40	Very slight.	None.	.40	Slight.	3.50	1.00	.0008	.0092	.19	.0140	.0000	-	1.33	1.26	83

LAWRENCE.

Chemical Examination of Water from a Faucet at the Lawrence Experiment Station, supplied from the Lawrence Water Works — Concluded.

[Parts per 100,000.]

Number.	Date of		Temperature, F°.	Appearance.			Odor.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Dissolved Oxygen.	Oxygen required for Saturation.	Bacteria in one Cubic Centimeter.
	Collection.	Exam-ination.		Turbidity.	Sediment.	Color.		Total.	Loss on Ignition.	Free.	Albu-minoid.		Nitrates.	Nitrites.				
	1890 — Con.																	
4127	Feb. 4	Feb. 4	39	Slight.	None.	.30	Slight.	3.60	0.90	.0012	.0122	.19	.0100	.0000	-	1.33	1.28	196
4166	11	11	39	None.	None.	.30	Slight.	3.50	1.00	.0014	.0124	.19	.0180	.0000	-	1.30	1.28	175
4197	18	18	39	None.	None.	.30	Slight.	3.20	1.00	.0018	.0102	.18	.0200	.0000	-	1.24	1.29	74
4227	25	25	38	Slight.	None.	.30	Slight.	3.60	1.10	.0016	.0084	.18	.0120	.0000	-	1.22	1.30	-
4257	Mar. 4	Mar. 4	38	Very slight.	None.	.30	Slight.	3.40	1.10	.0028	.0122	.19	.0120	.0000	.29	1.24	1.30	217
4285	11	11	38	Slight.	Slight.	.30	Slight.	3.40	1.00	.0030	.0140	.17	.0200	.0000	.29	1.25	1.30	80
4314	18	18	38	Slight.	None.	.30	None.	3.20	0.70	.0040	.0130	.18	.0160	.0000	.25	1.23	1.30	-
4345	25	25	38	Very slight.	None.	.30	None.	3.10	1.00	.0018	.0110	.16	.0080	.0000	.28	1.21	1.30	-
4372	April 1	April 1	38	Slight.	Slight.	.30	None.	3.60	1.20	.0012	.0108	.16	.0180	.0000	.26	1.21	1.30	-
4406	8	8	40	Slight.	None.	.20	None.	3.60	1.20	.0014	.0120	.16	.0120	.0000	.24	1.14	1.26	-
4439	15	15	41	Decided.	Much, red.	.60	Decided.	4.30	1.10	.0020	.0164	.21	.0140	.0000	.28	1.09	1.24	-
4470	22	22	43	Slight.	None.	.30	None.	4.30	1.60	.0016	.0126	.14	.0200	.0000	.26	1.06	1.21	-
4506	29	29	45	Slight.	None.	-	Slight.	3.30	1.30	.0024	.0124	.15	.0080	.0000	.26	1.01	1.19	-
4545	May 6	May 6	48	Very slight.	None.	.20	None.	3.00	1.00	.0016	.0120	.14	.0200	.0000	.27	.89	1.15	-
4587	13	13	50	None.	Slight.	.30	None.	-	-	.0010	.0124	.13	.0180	.0000	.32	.84	1.12	-
4621	20	20	52	Very slight.	None.	.20	None.	3.50	1.30	.0012	.0104	.12	.0120	.0000	.31	.72	1.09	-
4655	27	27	54	Very slight.	None.	.20	None.	3.20	0.80	.0014	.0126	.12	.0200	.0000	.34	.72	1.07	-
4689	June 3	June 3	55	Very slight.	Very slight.	.20	None.	-	-	.0020	.0183	.12	.0080	.0000	.34	.71	1.05	-
4722	10	10	56	Very slight.	Very slight.	.20	None.	-	-	.0022	.0110	.13	.0200	.0000	.33	.67	1.04	-
4759	17	17	57	None.	None.	.30	None.	-	-	.0016	.0142	.12	.0080	.0000	.33	.67	1.02	-
4792	24	24	60	None.	None.	.20	None.	-	-	.0016	.0126	.15	.0280	.0000	.34	.63	.99	33

LAWRENCE.

4829	July 1	July 1	63	None.	None.	.20	Very slight.	-	-	.0022	.0124	.16	.0400	.0000	.31	.48	.95	39
4863	8	8	67	None.	None.	.20	Very slight.	-	-	.0024	.0148	.18	.0240	.0000	.24	.45	.91	101
4903	15	15	70	None.	None.	.20	Very slight.	-	-	.0026	.0128	.20	.0240	.0000	.30	.55	.88	310
4942	22	22	68	None.	None.	.30	Very slight.	-	-	.0014	.0154	.21	.0200	.0000	.26	.43	.90	35
4983	29	29	68	None.	None.	.30	Slight.	-	-	.0014	.0106	.23	.0240	.0000	.24	.45	.90	44
5019	Aug. 5	Aug. 5	72	None.	None.	.30	Slight.	-	-	.0010	.0144	.21	.0180	.0000	.22	.36	.86	82
5055	12	12	70	None.	None.	.30	Slight.	4.44	1.44	.0028	.0144	.22	.0240	.0000	.27	.38	.89	81
5097	19	19	68	None.	None.	.20	Very slight.	-	-	.0080	.0196	.22	.0270	.0000	.22	.44	.90	99
5139	26	26	69	None.	None.	.20	Very slight.	5.04	0.96	.0010	.0126	.24	.0240	.0000	.22	.44	.89	126
5174	Sept. 2	Sept. 2	66	None.	None.	.20	Very slight.	4.64	0.60	.0024	.0116	.20	.0240	.0000	.28	.50	.92	-
5205	9	9	66	None.	None.	.30	Slight.	-	-	.0020	.0134	.18	.0240	.0000	.37	.47	.92	-
5239	16	16	66	None.	None.	.30	Very slight.	-	-	.0008	.0140	.17	.0200	.0000	.39	.52	.92	-
5273	23	23	64	None.	None.	.30	Very slight.	-	-	.0018	.0122	.16	.0240	.0000	.31	.62	.94	31
5305	30	30	62	None.	None.	.30	Very slight.	-	-	.0012	.0156	.15	.0120	.0000	-	.69	.96	264
5334	Oct. 7	Oct. 7	59	None.	None.	.30	None.	-	-	.0008	.0108	.16	.0130	.0000	.40	.73	1.00	226
5365	14	14	55	Very slight.	None.	.20	None.	-	-	.0008	.0124	.18	.0140	.0000	.44	.78	1.04	230
5400	21	21	52	None.	None.	.30	None.	-	-	.0004	.0102	.16	.0160	.0000	.33	.87	1.09	164
5430	28	28	55	Very slight.	None.	.30	None.	-	-	.0004	.0146	.18	.0180	.0000	.49	.94	1.04	104
5477	Nov. 4	Nov. 5	-	None.	None.	.37	Very slight.	-	-	.0004	.0114	.17	.0190	.0000	.40	-	-	80
5514	11	11	50	None.	None.	.30	None.	-	-	.0012	.0110	.14	.0190	.0000	.41	1.08	1.11	83
5556	18	18	52	None.	None.	.25	None.	-	-	.0002	.0134	.18	.0190	.0000	.37	1.07	1.09	92
5608	25	25	51	Very slight.	None.	.27	None.	-	-	.0010	.0098	.16	.0280	.0000	.38	1.13	1.10	220
5643	Dec. 2	Dec. 2	47	None.	None.	.30	None.	-	-	.0006	.0106	.19	.0310	.0000	.39	1.16	1.16	630
5683	9	9	44	None.	None.	.27	None.	-	-	.0008	.0116	.20	.0410	.0000	.37	1.23	1.20	1,360
5725	16	16	41	None.	Very slight.	.27	None.	-	-	.0014	.0114	.20	.0320	.0000	.33	1.27	1.24	470
5763	23	23	37	None.	None.	.24	None.	-	-	.0024	.0118	.22	.0230	.0000	.31	1.20	1.32	100
5804	31	31	38	None.	None.	.23	Slight.	-	-	.0040	.0130	.22	.0250	.0001	.32	1.23	1.30	94
Av.	-	-	-	-	-	.28	-	-	-	.0015	.0130	.18	.0172	.0000	-	-	-	-

LAWRENCE.

Volume of Water Flowing in the Merrimack River on the Dates when Samples of Water were collected for Analysis.

DATE.	VOLUME FLOWING IN THE RIVER IN CUBIC FEET PER SECOND. Rate of Flow during Eleven Hours of the Day.	VOLUME FLOWING IN THE RIVER IN CUBIC FEET PER SECOND. Rate of Flow during Twenty-four Hours of the Day.
1889.		
June 19,	6,550	5,500
July 17,	3,500	2,200
Aug. 14,	5,880	4,800
Sept. 11,	3,180	2,120
Oct. 15,	8,980	7,880
Nov. 19,	6,380	5,200
Dec. 18,	12,300	11,320
1890.		
Feb. 13,	11,240	10,480
April 15,	24,770	24,020
May 14,	10,100	9,300
June 18,	9,970	9,100
July 15,	4,250	3,330
Aug. 19,	3,250	2,300
Sept. 10,	5,700	4,870
Sept. 17,	14,750	13,900
Oct. 15,	6,750	5,900
Nov. 12,	9,400	8,550
Dec. 16,	6,400	5,560

WATER SUPPLY OF LENOX. — LENOX WATER COMPANY.

Chemical Examination of Water from a Brook near the Pumping-station of the Lenox Water Company.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
5116	Aug. 29	Aug. 31	V. sl't.	Cons.	0.05	9.25	0.70	.0020	.0044	.0038	.0006	.07	.0050	.0000	7.8

Odor, none. —— The sample was collected from the brook near the pumping-station. Water is pumped from this brook into the distributing reservoir which supplies the town when the supply from the other sources is insufficient.

Microscopical Examination.

Diatomaceæ, *Meridion*, pr.; *Navicula*, 1; *Pleurosigma*, 1; *Synedra*, 6. Total organisms, 8.

WATER SUPPLY OF LEOMINSTER.

Chemical Examination of Water from Haynes Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Sus-pended.				
	1889.														
4833	June 13	June 14	Slight.	Slight.	0.30	–	–	.0002	.0316	.0212	.0104	–	.0030	.0000	–
4922	July 8	July 9	Dec'd.	Cons.	0.30	–	–	.0004	.0442	.0344	.0098	–	.0030	.0000	–
4958	July 19	July 20	Dec'd.	Cons.	0.40	–	–	.0020	.0638	.0364	.0274	–	.0050	.0001	–
5047	Aug. 12	Aug. 13	Dist't.	Cons.	0.25	–	–	.0006	.0864	.0366	.0498	–	.0040	.0000	–
5144	Sept. 4	Sept. 5	Dec'd.	Slight	0.15	–	–	.0006	.1078	.0368	.0710	–	.0030	.0000	–
5159	Sept. 9	Sept. 10	Dec'd.	Slight.	0.40	–	–	.0028	.0622	.0344	.0278	–	.0020	.0000	–
5202	Sept. 25	Sept. 26	Dist't.	Cons.	0.30	–	–	.0002	.0510	.0266	.0244	–	.0020	.0001	–
5235	Oct. 8	Oct. 9	Slight.	Cons.	0.20	–	–	.0018	.0430	.0280	.0150	–	.0020	.0001	–
5250	Oct. 10	Oct. 15	Slight.	Cons.	0.30	–	–	.0032	.0350	.0264	.0086	–	.0020	.0000	–
5291	Oct. 31	Nov. 1	Dist't.	Cons.	0.30	–	–	.0020	.0292	.0222	.0070	–	.0050	.0000	–
5344	Nov. 13	Nov. 13	Dist't.	Cons.	0.40	–	–	.0010	.0338	.0248	.0090	–	.0100	.0002	–
5380	Nov. 25	Nov. 26	Slight.	Slight.	0.30	–	–	.0006	.0302	.0258	.0044	–	.0030	.0001	–
5443	Dec. 16	Dec. 17	Dist't.	Slight.	0.20	–	–	.0016	.0252	.0180	.0072	–	.0020	.0001	–
	1890.														
5671	Feb. 13	Feb. 14	Slight.	V. sl't.	0.15	–	–	.0000	.0214	.0158	.0056	–	.0020	.0001	–
5792	Mar. 17	Mar. 18	V. sl't.	Slight.	0.30	–	–	.0004	.0176	.0100	.0076	.12	.0100	.0000	–
5886	Apr. 15	Apr. 16	Slight.	Cons.	0.05	–	–	.0002	.0152	.0120	.0032	.09	.0050	.0000	–
5992	May 19	May 20	Dec'd.	Cons.	0.10	–	–	.0000	.0348	.0184	.0164	.10	.0030	.0000	–
6111	June 22	June 24	Dec'd.	Cons.	0.30	–	–	.0012	.0506	.0248	.0258	.10	.0060	.0001	–
6212	July 14	July 14	Dec'd.	Cons.	0.20	2.95	–	.0000	.0976	.0352	.0624	.12	.0020	.0000	–
6415	Aug. 18	Aug. 19	Dec'd.	Heavy.	0.20	3.45	2.40	.0000	.1166	.0250	.0916	.12	.0085	.0000	0.6
6510	Sept. 15	Sept. 16	Dec'd.	Very heavy.	0.15	2.80	1.80	.0004	.0866	.0182	.0684	.11	.0030	.0000	0.6
6648	Oct. 27	Oct. 29	Dist't.	Cons.	0.35	3.05	1.65	.0002	.0416	.0224	.0192	.13	.0050	.0002	0.6
6731	Nov. 17	Nov. 18	Dist't.	Heavy.	0.20	2.40	1.25	.0010	.0364	.0230	.0134	.14	.0050	.0001	0.6
6828	Dec. 15	Dec. 16	V. sl't.	V. sl't.	0.30	2.60	1.20	.0002	.0318	.0264	.0054	.12	.0200	.0002	0.9
Av.	....	....	....	....	0.24	2.86	1.66	.0006	.0494	.0237	.0257	.11	.0052	.0001	0.6

Odor, generally faintly vegetable, occasionally also grassy; when heated, the odor is much stronger, generally grassy, occasionally disagreeable. —— The samples were collected from the reservoir, near the gate-house, at a depth of about one foot beneath the surface.

LEOMINSTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							
	June.	July.	July.	Aug.	Sept.	Sept.	Sept.	Oct.
Day of examination,	14	10	20	13	10	10	26	10
Number of sample,	4833	4922	4958	5047	5144	5159	5202	5235
PLANTS.								
Diatomaceæ,	**167**	**74**	**238**	**172**	**80**	**128**	**240**	**410**
Asterionella,	150	45	184	0	8	34	36	216
Melosira,	11	11	0	158	48	92	159	89
Navicula,	0	0	0	0	0	0	1	0
Synedra,	0	0	0	0	0	0	1	5
Tabellaria,	6	18	54	14	24	2	43	100
Cyanophyceæ,	**3**	**73**	**526**	**672**	**1,056**	**464**	**154**	**51**
Anabæna,	0	67	452	636	1,016	424	11	8
Chroöcoccus,	0	0	34	0	0	0	80	0
Clathrocystis,	3	6	6	28	20	20	20	6
Cœlosphærium,	0	0	34	8	20	20	43	37
Nostocaceous spores,	0	0	0	0	0	0	0	0
Algæ,	**31**	**101**	**164**	**18**	**62**	**268**	**171**	**361**
Arthrodesmus,	0	0	0	0	0	0	2	5
Chlorococcus,	10	72	120	0	40	238	69	177
Cœlastrum,	0	4	0	0	4	0	1	5
Cosmarium,	0	0	0	0	0	0	0	0
Dictyosphærium,	0	0	0	0	0	0	8	21
Merismopedia,	5	0	16	0	0	0	0	pr.
Pediastrum,	2	3	4	10	4	18	5	5
Pleurococcus,	0	0	0	0	0	0	0	0
Protococcus,	0	0	0	0	0	0	50	0
Raphidium,	4	0	20	0	10	0	20	122
Scenedesmus,	0	6	0	2	0	2	4	4
Spirotænia,	0	0	0	0	0	0	0	3
Staurastrum,	10	16	4	6	4	10	12	19
Fungi. Crenothrix,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ANIMALS.								
Rhizopoda. Actinophrys,	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**pr.**
Infusoria,	**0**	**45**	**2**	**0**	**6**	**24**	**19**	**3**
Ciliated infusorian,	0	9	0	0	0	0	0	0
Dinobryon,	0	8	0	0	0	0	19	1
Monas,	0	4	0	0	0	0	0	0
Peridinium,	0	22	0	0	0	2	0	0
Trachelomonas,	0	2	2	0	6	22	0	2
Vermes,	**pr.**	**0**	**pr.**	**0**	**2**	**0**	**4**	**3**
Anurea,	pr.	0	0	0	0	0	1	2
Polyarthra,	0	0	pr.	0	2	0	2	1
Rotatorian ova,	0	0	0	0	0	0	1	0
Rotifer,	0	0	pr.	0	0	0	0	0
Crustacea. Daphnia,	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	201	293	936	862	1,206	884	588	828

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1889.					1890.		
	Oct.	Oct.	Nov.	Nov.	Dec.	Feb.	Mar.	April.
Day of examination,	16	-	14	27	18	15	19	18
Number of sample,	5250	5291	5344	5380	5443	5671	5792	5886
PLANTS.								
Diatomaceæ,	**829**	**2,056**	**1,410**	**169**	**112**	**1,278**	**15**	**274**
Asterionella,	498	1,144	1,188	100	70	92	8	146
Melosira,	146	12	40	11	3	0	pr.	28
Navicula,	0	0	0	0	0	0	0	0
Synedra,	42	448	56	12	23	1,176	5	84
Tabellaria,	143	452	126	46	16	10	2	16
Cyanophyceæ,	**31**	**pr.**	**8**	**1**	**4**	**1**	**0**	**3**
Anabæna,	12	pr.	6	pr.	0	0	0	2
Chroöcoccus,	0	0	0	0	2	0	0	0
Clathrocystis,	4	pr.	2	0	2	0	0	0
Cœlosphærium,	15	pr.	0	1	0	1	0	1
Nostocaceous spores,	0	0	0	pr.	0	0	0	0
Algæ,	**92**	**148**	**62**	**21**	**32**	**25**	**19**	**23**
Arthrodesmus,	6	4	12	3	2	2	0	1
Chlorococcus,	33	80	18	11	9	18	15	10
Cœlastrum,	pr.	0	0	0	0	0	0	0
Cosmarium,	0	0	0	0	0	0	0	0
Dictyosphærium,	11	0	0	pr.	pr.	0	0	1
Merismopedia,	pr.	0	0	0	0	0	0	0
Pediastrum,	4	16	2	pr.	0	1	0	1
Pleurococcus,	0	40	0	0	0	0	0	0
Protococcus,	0	0	0	0	0	0	0	0
Raphidium,	13	0	0	0	5	0	0	0
Scenedesmus,	3	8	2	2	6	3	4	8
Spirotænia,	0	0	0	0	0	0	0	0
Staurastrum,	22	0	28	5	10	1	0	2
Fungi. Crenothrix,	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**
ANIMALS.								
Rhizopoda. Actinophrys,	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**4**	**pr.**	**214**	**50**	**116**	**349**	**229**	**533**
Ciliated infusorian,	0	pr.	0	0	0	0	0	0
Dinobryon,	pr.	pr.	208	46	109	342	220	498
Monas,	0	0	0	0	pr.	0	pr.	0
Peridinium,	0	0	6	4	5	7	9	34
Trachelomonas,	4	0	0	0	2	0	0	1
Vermes,	**1**	**pr.**	**6**	**pr.**	**1**	**2**	**2**	**3**
Anurea,	pr.	0	0	0	1	1	2	2
Polyarthra,	1	0	0	pr.	0	0	0	0
Rotatorian ova,	0	0	2	0	0	1	0	1
Rotifer,	0	pr.	4	0	0	0	0	0
Crustacea. Daphnia,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	957	2,204	1,700	241	265	1,655	265	836

LEOMINSTER.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.							
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	20	25	15	19	16	30	18	17
Number of sample,	5992	6111	6212	6415	6510	6648	6731	6828
PLANTS.								
Diatomaceæ,	**1,848**	**226**	**169**	**198**	**604**	**3,608**	**397**	**59**
Asterionella,	1,004	16	8	0	8	1,552	128	0
Melosira,	568	6	153	126	404	372	184	2
Navicula,	0	0	0	2	4	4	0	0
Synedra,	112	0	5	14	84	168	29	43
Tabellaria,	164	204	3	56	104	1,512	56	14
Cyanophyceæ,	**38**	**216**	**928**	**1,966**	**380**	**432**	**3**	**0**
Anabæna,	16	136	520	132	0	4	1	0
Chroöcoccus,	0	0	0	122	0	396	0	0
Clathrocystis,	18	48	195	1,708	380	32	2	0
Cœlosphærium,	4	32	38	4	0	0	0	0
Nostocaceous spores,	0	0	175	0	0	0	0	0
Algæ,	**674**	**78**	**200**	**310**	**168**	**594**	**8,787**	**16**
Arthrodesmus,	0	0	3	14	0	10	0	0
Chlorococcus,	538	16	45	158	16	45	8,744	1
Cœlastrum,	0	0	0	0	6	1	0	0
Cosmarium,	0	2	0	4	54	208	0	0
Dictyosphærium,	24	0	5	0	0	0	0	0
Merismopedia,	0	0	0	0	0	0	0	0
Pediastrum,	28	8	43	12	16	5	1	0
Pleurococcus,	0	0	0	0	0	0	0	0
Protococcus,	0	0	0	0	0	0	0	0
Raphidium,	42	44	18	4	12	33	20	0
Scenedesmus,	32	4	13	100	54	220	22	13
Spirotænia,	0	0	65	0	0	0	0	0
Staurastrum,	10	4	8	18	10	72	0	2
Fungi. Crenothrix,	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**
ANIMALS.								
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**18**	**126**	**3**	**42**	**2**	**2**	**1**	**4**
Ciliated infusorian,	0	0	0	0	0	0	0	0
Dinobryon,	16	124	0	0	0	1	0	pr.
Monas,	0	0	0	0	0	0	0	pr.
Peridinium,	0	2	0	42	0	1	1	4
Trachelomonas,	2	0	3	0	2	0	0	0
Vermes,	**22**	**0**	**0**	**2**	**6**	**1**	**0**	**0**
Anurea,	4	0	0	2	4	0	0	0
Polyarthra,	12	0	0	0	0	0	0	0
Rotatorian ova,	6	0	0	0	0	0	0	0
Rotifer,	0	0	0	0	2	1	0	0
Crustacea. Daphnia,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**
TOTAL ORGANISMS,	2,600	646	1,305	2,518	1,160	4,637	9,188	79

Chemical Examination of Water from Faucets in Leominster.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Suspended.		Nitrates.	Nitrites.	
	1890.														
5553	Jan. 20	Jan. 21	Dist't.	Cons.	0.25	–	–	.0006	.0198	.0090	.0108	–	.0070	.0000	–
6625	Oct. 20	Oct. 21	V. sl't.	Slight.	0.45	2.55	1.20	.0008	.0202	.0162	.0040	.12	.0080	.0002	0.6

Odor, very faintly vegetable.—The samples were collected from faucets in the village, supplied with water from the Leominster Water Works.

Microscopical Examination.

No. 5553. Diatomaceæ, *Asterionella*, 15; *Ceratoneis*, 4; *Cocconema*, 1; *Epithemia*, 1; *Gonphonema*, 1; *Melosira*, 12; *Meridion*, 2; *Navicula*, 7; *Synedra*, 19; *Tabellaria*, 5. Cyanophyceæ, *Cœlosphærium*, 2. Algæ, *Arthrodesmus*, 2; *Pediastrum*, 1; *Scenedesmus*, 5; *Staurastrum*, 1. Fungi, *Crenothrix*, 218; *Leptothrix*, 1. Infusoria, *Dinobryon*, 7; *Monas*, 1; *Peridinium*, 3. Vermes, *Anurea*, 1. Total organisms, 309.

No. 6625. Diatomaceæ, *Asterionella*, 68; *Melosira*, 20; *Navicula*, 5; *Synedra*, 8; *Tabellaria*, 38. Cyanophyceæ, *Clathrocystis*, 5. Algæ, *Cosmarium*, 20; *Pediastrum*, 2; *Arthrodesmus*, 3; *Raphidium*, 2; *Scenedesmus*, 82; *Staurastrum*, 3. Fungi, *Crenothrix*, 1. Total organisms, 257.

WATER SUPPLY OF LOWELL.

Chemical Examination of Water from the Merrimack River above Lowell, opposite the Inlet to the Lowell Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4853	June 18	June 20	Dist't.	Cons., earthy.	0.25	–	–	.0032	.0156	.0154	.0002	–	.0060	.0001	–
4944	July 16	July 17	V. sl't.	Slight.	0.25	–	–	.0032	.0168	.0148	.0020	–	.0080	.0002	–
5057	Aug. 13	Aug. 14	V. sl't.	Cons.	0.30	–	–	.0034	.0192	.0148	.0044	.14	.0030	.0002	–
5160	Sept. 10	Sept. 11	V. sl't.	Slight, earthy.	0.20	–	–	.0036	.0156	.0128	.0028	.18	.0120	.0001	–
5251	Oct. 14	Oct. 15	Slight.	Slight.	0.70	–	–	.0026	.0196	.0166	.0030	.18	.0030	.0001	–
5355	Nov. 18	Nov. 19	V. sl't.	V. sl't.	0.50	–	–	.0008	.0126	.0112	.0014	.17	.0080	.0001	–
5463	Dec. 17	Dec. 19	V. sl't.	Slight, earthy.	0.20	–	–	.0000	.0148	.0100	.0048	.14	.0120	.0001	–

LOWELL.

Chemical Examination of Water from the Merrimack River above Lowell, opposite the Inlet to the Lowell Water Works — Concluded.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1890.														
5532	Jan. 14	Jan. 16	V. sl't.	V. sl't.	0.20	–	–	.0010	.0074	.0056	.0018	.15	.0120	.0001	–
5652	Feb. 12	Feb. 13	Dist't.	Slight.	0.45	–	–	.0002	.0114	.0098	.0016	.12	.0150	.0000	–
5775	Mar. 11	Mar. 12	Slight.	Slight, clayey.	0.25	–	–	.0006	.0082	.0072	.0010	.13	.0110	.0000	–
5881	Apr. 14	Apr. 15	Dist't.	Heavy, earthy.	0.20	–	–	.0004	.0132	.0090	.0042	.08	.0050	.0000	–
5990	May 16	May 17	Dist't.	Heavy, earthy.	0.30	–	–	.0000	.0130	.0108	.0022	.11	.0080	.0000	–
6086	June 17	June 18	Slight.	Slight.	0.30	–	–	.0022	.0132	.0104	.0028	.12	.0080	.0002	–
6226	July 14	July 15	Slight.	Slight.	0.20	4.40	–	.0026	.0156	.0114	.0042	.15	.0070	.0003	1.4
6491	Sept. 10	Sept. 11	Slight.	Cons.	0.30	4.15	2.40	.0054	.0172	.0154	.0018	.16	.0150	.0002	1.9
6538	Sept. 27	Sept. 29	V. sl't.	Slight, earthy.	0.40	–	–	.0028	.0168	.0146	.0022	.13	.0150	.0002	–
6609	Oct. 15	Oct. 16	V. sl't.	Slight.	0.45	3.60	1.20	.0022	.0152	.0128	.0024	.13	.0080	.0004	1.1
6726	Nov. 13	Nov. 14	V. sl't.	V. sl't.	0.40	3.25	1.15	.0006	.0132	.0118	.0014	.16	.0150	.0000	1.3
6829	Dec. 15	Dec. 16	V. sl't	V. sl't.	0.20	3.30	1.40	.0018	.0136	.0108	.0028	.14	.0180	.0002	1.3
Av.	....	....	....	....	0.32	3.57	1.54	.0018	.0142	.0117	.0025	.14	.0097	.0001	1.4

Odor, generally faintly vegetable, frequently mouldy, occasionally none.—— The samples were collected from the river opposite the inlet to the Lowell Water Works, one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889. June.	1889. July.	1889. Aug.	1889. Sept.	1889. Oct.	1889. Nov.	1889. Dec.	1890. Jan.	1890. Feb.
Day of examination,	20	17	14	11	16	19	21	16	15
Number of sample,	4853	4944	5057	5160	5251	5355	5463	5532	5652
PLANTS.									
Diatomaceæ,	**4**	**5**	**10**	**18**	**14**	**13**	**0**	**3**	**9**
Asterionella,	2	0	5	2	2	8	0	0	pr.
Melosira,	pr.	0	2	2	5	0	0	0	6
Synedra,	2	2	pr.	5	pr.	2	0	3	3
Tabellaria,	pr.	3	3	9	7	3	0	0	pr.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
PLANTS — Con.									
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	0	0	0	0
Algæ. Chlorococcus, . . .	4	39	8	16	3	0	pr.	0	0
Fungi. Crenothrix, . . .	0	0	5	2	3	pr.	15	0	2
ANIMALS.									
Infusoria. Dinobryon, . .	0	22	5	24	1	2	pr.	1	0
Porifera. Sponge spicules, .	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS, . .	8	66	28	60	21	15	15	4	11

	1890.									
	Mar.	April.	May.	June.	July.	Sept.	Oct.	Oct.	Nov.	Dec.
Day of examination, ...	15	16	20	18	16	11	1	17	14	17
Number of sample, ...	5775	5881	5990	6086	6226	6491	6538	6609	6726	6829
PLANTS.										
Diatomaceæ, ...	2	29	58	13	73	24	2	0	2	3
Asterionella, ...	0	1	9	4	25	3	2	0	pr.	0
Melosira, ...	0	22	14	4	17	2	0	0	2	3
Synedra, ...	2	5	31	5	26	4	0	0	0	0
Tabellaria, ...	0	1	4	0	5	15	0	0	0	0
Cyanophyceæ. Chroöcoccus, .	0	0	0	0	5	20	0	pr.	0	0
Algæ. Chlorococcus, ...	0	0	1	0	149	0	0	0	2	0
Fungi. Crenothrix, ...	3	0	0	pr.	3	2	17	13	0	0
ANIMALS.										
Infusoria. Dinobryon, ...	0	0	0	0	0	0	0	0	0	0
Porifera. Sponge spicules, . .	0	0	0	0	0	0	0	0	pr.	0
TOTAL ORGANISMS, ...	5	29	59	13	230	46	19	13	4	3

LYNN.

WATER SUPPLY OF LYNN.

Chemical Examination of Water from Breed's Pond, Lynn.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4835	June 13	June 14	Slight.	Slight.	0.25	-	-	.0002	.0232	.0168	.0064	-	.0020	.0001	-
4950	July 16	July 18	Slight.	V. sl't.	0.50	-	-	.0024	.0228	.0198	.0030	-	.0020	.0001	-
5069	Aug. 16	Aug. 17	Slight.	Slight.	0.50	-	-	.0008	.0232	.0192	.0040	-	.0030	.0001	-
5178	Sept. 16	Sept. 17	Slight.	Slight.	0.65	-	-	.0006	.0220	.0194	.0026	-	.0030	.0000	-
5253	Oct. 15	Oct. 16	Slight.	Cons.	0.30	-	-	.0004	.0272	.0194	.0078	-	.0020	.0000	-
5357	Nov. 18	Nov. 19	V. sl't.	Slight.	0.70	-	-	.0000	.0194	.0150	.0044	-	.0050	.0001	-
5434	Dec. 11	Dec. 12	V. sl't.	V. sl't.	0.40	-	-	.0012	.0216	.0180	.0036	-	.0050	.0000	-
	1890.														
5531	Jan. 14	Jan. 15	V. sl't.	Slight.	0.40	-	-	.0002	.0148	.0140	.0008	-	.0070	.0001	-
5648	Feb. 12	Feb. 13	Slight.	Slight.	0.70	-	-	.0000	.0160	.0126	.0034	-	.0060	.0000	-
5767	Mar. 11	Mar. 12	Slight.	Slight.	0.45	-	-	.0002	.0140	.0080	.0060	.43	.0020	.0001	-
5891	Apr. 15	Apr. 16	Slight.	Cons., earthy.	0.30	-	-	.0000	.0158	.0118	.0040	.39	.0030	.0000	-
5984	May 14	May 16	Dist't.	Cons.	0.30	-	-	.0004	.0176	.0132	.0044	.37	.0030	.0000	-
6091	June 18	June 19	Slight.	Slight.	0.40	-	-	.0000	.0182	.0154	.0028	.36	.0030	.0001	-
6239	July 15	July 16	Slight.	Slight.	0.25	3.15	-	.0014	.0224	.0150	.0074	.42	.0000	.0000	1.3
6412	Aug. 14	Aug. 15	Slight.	Slight.	0.35	3.25	1.50	.0024	.0242	.0188	.0054	.47	.0050	.0002	1.3
6504	Sept. 10	Sept. 11	Dist't.	Slight.	-	-	-	.0004	.0244	.0174	.0070	.43	.0080	.0001	1.4
6594	Oct. 14	Oct. 15	V. sl't.	V. sl't.	0.40	3.30	1.35	.0042	.0192	.0152	.0040	.38	.0080	.0002	0.9
6711	Nov. 11	Nov. 11	V. sl't.	None.	0.60	4.40	1.95	.0054	.0214	.0194	.0020	.45	.0070	.0001	0.9
6807	Dec. 10	Dec. 11	V. sl't.	V. sl't.	0.50	3.55	1.25	.0016	.0274	.0248	.0026	.43	.0100	.0002	1.1
Av.	....	....	....	....	0.44	3.62	1.51	.0011	.0208	.0165	.0043	.41	.0044	.0001	1.1

Odor, generally distinctly vegetable and frequently also disagreeable; rarely none. —— The samples were collected from the pond near the gate-house, at a depth of about one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	15	18	16	17	17	21	14	16	15	14
Number of sample,	4835	4950	5069	5178	5253	5357	5434	5531	5648	5767
PLANTS.										
Diatomaceæ,	**56**	**50**	**59**	**118**	**354**	**560**	**473**	**608**	**669**	**332**
Asterionella,	20	4	18	0	58	476	376	460	628	272
Melosira,	1	0	0	0	0	0	0	0	0	0
Synedra,	pr.	pr.	0	0	pr.	16	57	84	17	4
Tabellaria,	35	46	41	118	296	68	40	64	24	56
Cyanophyceæ,	**0**	**0**	**23**	**pr.**	**1**	**0**	**0**	**0**	**0**	**0**
Anabæna,	0	0	23	0	0	0	0	0	0	0
Clathrocystis,	0	0	0	pr.	1	0	0	0	0	0
Algæ,	**0**	**2**	**12**	**2**	**67**	**2**	**6**	**5**	**1**	**0**
Chlorococcus,	0	2	12	0	43	0	6	5	0	0
Raphidium,	0	0	0	0	16	0	0	0	0	0
Staurastrum,	0	0	0	2	8	2	0	0	1	0
ANIMALS.										
Rhizopoda,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Actinophrys,	0	0	0	0	0	0	0	0	0	0
Difflugia,	0	0	0	0	0	0	0	0	0	0
Infusoria,	**0**	**pr.**	**79**	**3**	**1**	**0**	**6**	**7**	**4**	**19**
Dinobryon,	0	0	79	2	0	0	0	6	0	4
Monas,	0	0	0	0	0	0	5	1	0	13
Peridinium,	0	pr.	0	0	1	0	1	0	4	2
Trachelomonas,	0	pr.	0	1	0	0	0	0	0	0
Vermes. Anurea,	**pr.**	**pr.**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**
Crustacea. Cyclops,	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	56	52	173	123	423	564	485	620	674	351

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	24	19	16	18	13	16	12	12
Number of sample,	5891	5984	6091	6239	6412	6504	6594	6711	6807
PLANTS.									
Diatomaceæ,	**222**	**702**	**64**	**30**	**8**	**84**	**0**	**8**	**37**
Asterionella,	102	416	11	4	4	34	0	2	37
Melosira,	0	0	0	0	0	48	0	5	0
Synedra,	12	34	0	4	4	0	0	0	0
Tabellaria,	108	252	53	22	0	2	0	1	0
Cyanophyceæ,	**0**	**4**	**1**	**34**	**0**	**0**	**0**	**0**	**0**
Anabæna,	0	4	1	4	0	0	0	0	0
Clathrocystis,	0	0	0	30	0	0	0	0	0
Algæ,	**1**	**0**	**5**	**18**	**0**	**8**	**0**	**0**	**0**
Chlorococcus,	1	0	5	8	0	6	0	0	0
Raphidium,	0	0	0	8	0	0	0	0	0
Staurastrum,	0	0	0	2	0	2	0	0	0

LYNN.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.									
Rhizopoda,	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**7**	**38**
Actinophrys,	0	0	0	0	0	0	0	7	38
Difflugia,	0	0	0	0	0	4	0	0	0
Infusoria,	**4**	**0**	**pr.**	**4**	**0**	**4**	**0**	**0**	**0**
Dinobryon,	1	0	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	0	0
Peridinium,	3	0	0	4	0	0	0	0	0
Trachelomonas,	0	0	pr.	0	0	4	0	0	0
Vermes. Anurea,	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**
Crustacea. Cyclops,	**0**	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**pr.**
TOTAL ORGANISMS,	227	706	70	86	8	104	0	15	75

Chemical Examination of Water from Birch Pond, Lynn.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites	
	1889.														
4834	June 13	June 14	Slight.	Slight.	0.20	–	–	.0022	.0232	.0204	.0028	–	.0020	.0000	–
4951	July 16	July 18	Dist't.	Slight.	0.20	–	–	.0026	.0278	.0230	.0048	–	.0020	.0001	–
5068	Aug. 16	Aug. 17	Dist't.	Cons.	0.20	–	–	.0034	.0264	.0224	.0040	–	.0040	.0000	–
5179	Sept. 16	Sept. 17	Dist't.	Slight.	0.35	–	–	.0034	.0284	.0204	.0080	–	.0000	.0001	–
5254	Oct. 15	Oct. 16	Slight.	Slight.	0.40	–	–	.0000	.0220	.0182	.0038	–	.0020	.0000	–
5356	Nov. 18	Nov. 19	V. sl't.	Slight.	0.35	–	–	.0004	.0244	.0174	.0070	–	.0070	.0002	–
5435	Dec. 11	Dec. 12	V. sl't.	V. sl't.	0.25	–	–	.0024	.0248	.0206	.0042	–	.0150	.0001	–
	1890.														
5530	Jan. 14	Jan. 15	V. sl't.	V. sl't.	0.30	–	–	.0008	.0222	.0164	.0058	–	.0090	.0001	–
5647	Feb. 12	Feb. 13	V. sl't.	V. sl't.	0.40	–	–	.0028	.0160	.0144	.0016	–	.0150	.0001	–
5766	Mar. 11	Mar. 12	Slight.	V. sl't.	0.40	–	–	.0004	.0182	.0130	.0052	.43	.0060	.0002	–
5890	Apr. 15	Apr. 16	V. sl't.	Slight.	0.20	–	–	.0000	.0180	.0146	.0034	.40	.0090	.0001	–
5985	May 14	May 16	Slight.	Cons.	0.20	–	–	.0040	.0178	.0166	.0012	.42	.0080	.0001	–
6090	June 18	June 19	Dist't.	Slight.	0.20	–	–	.0008	.0246	.0158	.0088	.40	.0020	.0001	–
6241	July 15	July 16	Slight.	Slight.	0.20	3.20	–	.0008	.0222	.0180	.0042	.44	.0000	.0001	0.9
6409	Aug. 14	Aug. 15	Slight.	Cons.	0.40	3.35	1.60	.0004	.0292	.0204	.0088	.42	.0000	.0002	1.1
6503	Sept. 10	Sept. 11	Dist't.	Slight.	0.30	–	–	.0002	.0316	.0222	.0094	.43	.0150	.0001	1.3
6593	Oct. 14	Oct. 15	Slight.	Slight.	0.60	3.25	1.20	.0004	.0274	.0224	.0050	.38	.0070	.0001	0.9
6713	Nov. 11	Nov. 12	V. sl't.	V. sl't.	0.60	3.80	1.30	.0022	.0204	.0182	.0022	.46	.0100	.0001	0.9
6806	Dec. 10	Dec. 11	Slight.	Slight.	0.50	3.90	1.30	.0030	.0252	.0224	.0028	.42	.0250	.0001	1.1
Av.	....	....	....	....	0.33	3.57	1.35	.0016	.0237	.0188	.0049	.42	.0073	.0001	1.0

Odor, generally faintly vegetable, occasionally unpleasant, rarely none. —— The samples were collected from the pond near the gate-house, at a depth of one foot beneath the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	15	18	16	17	17	20	14	16	15
Number of sample,	4834	4951	5068	5179	5254	5356	5435	5530	5647
PLANTS.									
Diatomaceæ,	**1**	**419**	**365**	**509**	**272**	**588**	**228**	**30**	**10**
Asterionella,	0	272	50	286	211	44	78	15	10
Melosira,	1	0	9	6	0	0	0	0	0
Navicula,	0	0	4	0	0	0	0	0	0
Synedra,	0	0	0	0	1	0	0	0	0
Tabellaria,	pr.	147	302	217	60	544	150	15	0
Cyanophyceæ,	**pr.**	**12**	**2**	**5**	**0**	**1**	**0**	**0**	**0**
Chroöcoccus,	0	9	0	0	0	0	0	0	0
Clathrocystis,	pr.	3	2	5	0	1	0	0	0
Algæ,	**pr.**	**10**	**41**	**41**	**5**	**49**	**0**	**pr.**	**0**
Arthrodesmus,	0	2	0	1	pr.	2	0	0	0
Characium,	0	0	0	0	0	0	0	0	0
Chlorococcus,	0	4	38	40	0	23	0	0	0
Raphidium,	0	0	0	0	5	18	0	0	0
Staurastrum,	pr.	4	3	0	pr.	6	0	pr.	0
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**pr.**	**49**	**15**	**1**	**0**	**5**	**2**	**pr.**
Dinobryon,	0	0	49	2	0	0	0	0	0
Monas,	0	0	0	0	1	0	0	0	0
Peridinium,	0	pr.	pr.	1	0	0	5	2	pr.
Trachelomonas,	pr.	pr.	pr.	12	0	0	0	0	0
Vermes,	**pr.**	**0**	**0**	**pr.**	**0**	**1**	**0**	**pr.**	**2**
Anurea,	pr.	0	0	0	0	1	0	pr.	2
Polyarthra,	0	0	0	pr.	0	0	0	0	0
Triarthra,	0	0	0	0	0	0	0	0	0
Crustacea. Cyclops,	**pr.**	**0**	**0**	**pr.**	**0**	**0**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	1	441	457	570	278	639	233	32	12

LYNN.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	14	19	17	24	16	18	13	16	12	12
Number of sample,	5766	5890	5985	6090	6241	6409	6503	6593	6713	6806
PLANTS.										
Diatomaceæ,	**49**	**216**	**352**	**8**	**38**	**988**	**450**	**168**	**191**	**494**
Asterionella,	47	138	14	0	0	178	188	33	66	250
Melosira,	0	4	5	0	0	0	4	4	7	0
Navicula,	0	0	pr.	0	0	22	0	1	0	0
Synedra,	0	pr.	6	0	0	0	6	0	2	28
Tabellaria,	2	74	327	8	38	788	252	130	116	216
Cyanophyceæ,	**3**	**0**	**0**	**0**	**3**	**24**	**8**	**16**	**0**	**0**
Chroöcoccus,	3	0	0	0	0	0	0	8	0	0
Clathrocystis,	0	0	0	0	3	24	8	8	0	0
Algæ,	**pr.**	**2**	**34**	**80**	**44**	**140**	**2**	**6**	**0**	**8**
Arthrodesmus,	0	0	2	0	4	2	0	0	0	0
Characium,	0	0	0	76	0	0	0	0	0	0
Chlorococcus,	pr.	2	25	2	27	86	0	1	0	2
Raphidium,	0	0	3	0	0	24	0	4	0	6
Staurastrum,	0	0	4	2	13	28	2	1	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**7**
Infusoria,	**5**	**50**	**26**	**0**	**28**	**8**	**28**	**0**	**2**	**36**
Dinobryon,	0	43	24	0	8	0	28	0	0	0
Monas,	0	0	0	0	0	0	0	0	0	33
Peridinium,	5	7	2	0	20	0	0	0	2	3
Trachelomonas,	0	0	pr.	0	0	8	0	0	0	0
Vermes,	**0**	**0**	**pr.**	**2**	**3**	**0**	**0**	**0**	**pr.**	**1**
Anurea,	0	0	pr.	0	0	0	0	0	pr.	1
Polyarthra,	0	0	0	2	0	0	0	0	pr.	0
Triarthra,	0	0	0	0	3	0	0	0	0	0
Crustacea. Cyclops,	**0**	**0**	**pr.**	**0**	**pr.**	**2**	**0**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	57	268	412	90	116	1,162	488	190	197	546

Chemical Examination of Water from Glen Lewis Pond, Lynn.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
5529	Jan. 14	Jan. 15	V. sl't.	Slight.	0.60	5.10	1.75	.0010	.0178	.0130	.0048	.38	.0040	.0000	–
5650	Feb. 12	Feb. 13	V sl't.	V. sl't.	0.80	4.00	1.40	.0000	.0128	.0102	.0026	.36	.0050	.0000	–
5768	Mar. 11	Mar. 12	Slight.	Cons.	0.55	4.10	1.90	.0000	.0244	.0118	.0126	.36	.0040	.0001	–
5882	Apr. 14	Apr. 16	V. sl't.	Slight.	0.40	–	–	.0000	.0186	.0128	.0058	.35	.0020	.0000	–
5986	May 14	May 16	Slight.	Cons.	0.30	–	–	.0004	.0174	.0144	.0030	.35	.0080	.0001	–
6093	June 18	June 19	Dec'd.	Cons.	0.50	–	–	.0030	.0296	.0212	.0084	.34	.0000	.0000	–
6240	July 15	July 16	Dec'd.	Slight.	0.45	4.45	–	.0076	.0758	.0296	.0462	.37	.0020	.0000	1.1
6410	Aug. 14	Aug. 15	Slight.	Cons.	1.20	5.35	3.15	.0632	.0624	.0554	.0070	.38	.0050	.0003	1.1
6440	Aug. 25	Aug. 26	Dist't.	Cons.	1.10	–	–	.0632	.0902	.0746	.0156	.36	.0150	.0002	–
6441	Aug. 25	Aug. 26	Dist't.	Slight.	1.00	–	–	.0720	.0694	.0584	.0110	–	.0070	.0001	–
6502	Sept. 10	Sept. 11	Dist't.	Slight.	1.00	–	–	.1390	.0636	.0558	.0078	.40	.0130	.0002	1.4
6592	Oct. 14	Oct. 15	Slight.	Slight.	1.20	5.65	3.00	.1112	.0704	.0568	.0136	.31	.0080	.0005	1.1
6714	Nov. 11	Nov. 12	V. sl't.	V sl't.	1.40	4.80	2.15	.0740	.0438	.0388	.0050	.40	.0080	.0003	0.8
6805	Dec. 10	Dec. 11	Slight.	Cons.	0.75	4.90	2.10	.0954	.0836	.0630	.0206	.33	.0120	.0002	0.9
Av.	....	....	....	....	0.76	4.84	2.21	.0412	.0445	.0327	.0118	.36	.0063	.0001	1.0

Odor, generally distinctly vegetable, often grassy, frequently unpleasant; when heated, the odor is much increased and frequently disagreeable.—— The samples were collected from the pond near the gatehouse, at a depth of one foot beneath the surface, with the exception of No 6441, which was collected near the bottom.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.						
	Jan.	Feb.	Mar.	April.	May.	June.	July.
Day of examination, ...	15	15	14	16	17	24	16
Number of sample, ...	5529	5650	5768	5882	5986	6093	6240
PLANTS.							
Diatomaceæ, ...	**0**	**4**	**pr.**	**40**	**46**	**12,530**	**0**
Asterionella, ...	0	2	0	0	20	12,530	0
Stephanodiscus, ...	0	2	0	0	0	0	0
Synedra, ...	0	0	pr.	40	26	0	0
Cyanophyceæ, ...	**0**	**0**	**0**	**0**	**1,772**	**0**	**2,303**
Anabæna, ...	0	0	0	0	0	0	2,080
Aphanocapsa, ...	0	0	0	0	0	0	0
Chroöcoccus, ...	0	0	0	0	1,772	0	0
Clathrocystis, ...	0	0	0	0	0	0	8
Nostocaceous spores, ...	0	0	0	0	0	0	215
Algæ, ...	**4**	**11**	**0**	**pr.**	**0**	**0**	**131**
Chlorococcus, ...	0	4	0	0	0	0	118
Eudorina, ...	0	0	0	0	0	0	0
Pandorina, ...	0	0	0	0	0	0	13
Sorastrum, ...	0	0	0	0	0	0	0
Volvox, ...	0	0	0	0	0	0	0
Zoöspores, ...	4	7	0	pr.	0	0	0

LYNN.

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1890.						
	Jan.	Feb.	Mar.	April.	May.	June.	July.
PLANTS — Con.							
Fungi,	**5**	**2**	**2**	**32**	**46**	**0**	**0**
Crenothrix,	5	2	2	32	46	0	0
Leptothrix,	0	0	0	0	0	0	0
ANIMALS.							
Infusoria,	**774**	**78**	**9**	**14**	**10**	**0**	**18**
Cryptomonas,	0	0	0	0	0	0	0
Dinobryon,	772	75	pr.	0	0	0	0
Monas,	0	1	0	2	0	0	0
Peridinium,	0	0	0	0	10	0	18
Synura,	2	2	9	12	0	0	0
Vermes. Anurea,	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Crustacea,	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Daphnia,	0	0	0	0	0	0	0
Moina,	0	0	0	0	0	0	0
TOTAL ORGANISMS,	783	95	11	86	1,874	12,530	2,452

	1890.						
	Aug.	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	27	27	13	16	12	12
Number of sample,	6410	6440	6441	6502	6592	6714	6805
PLANTS.							
Diatomaceæ,	**2**	**0**	**0**	**44**	**2**	**0**	**0**
Asterionella,	0	0	0	0	0	0	0
Stephanodiscus,	0	0	0	42	2	0	0
Synedra,	2	0	0	2	0	0	0
Cyanophyceæ,	**10**	**208**	**3**	**0**	**0**	**0**	**0**
Anabæna,	10	34	0	0	0	0	0
Aphanocapsa,	0	112	3	0	0	0	0
Chroöcoccus,	0	62	0	0	0	0	0
Clathrocystis,	0	0	0	0	0	0	0
Nostocaceous spores,	0	0	0	0	0	0	0
Algæ,	**332**	**200**	**263**	**86**	**452**	**136**	**0**
Chlorococcus,	164	80	238	72	452	136	0
Eudorina,	168	0	2	0	0	0	0
Pandorina,	0	92	0	0	0	0	0
Sorastrum,	0	28	23	0	0	0	0
Volvox,	0	0	0	14	0	0	0
Zoöspores,	0	0	0	0	0	0	0
Fungi,	**156**	**312**	**60**	**4**	**2**	**6**	**0**
Crenothrix,	156	156	26	4	2	6	0
Leptothrix,	0	156	34	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.						
	Aug.	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.							
Infusoria,	**0**	**0**	**1**	**0**	**0**	**2**	**536**
Cryptomonas,	0	0	0	0	0	0	536
Dinobryon,	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	0
Peridinium,	0	0	1	0	0	2	0
Synura,	0	0	0	0	0	0	0
Vermes. Anurea,	**0**	**0**	**4**	**12**	**0**	**0**	**0**
Crustacea,	**pr.**	**0**	**2**	**0**	**0**	**0**	**0**
Daphnia,	pr.	0	0	0	0	0	0
Moina,	0	0	2	0	0	0	0
TOTAL ORGANISMS,	500	720	333	146	456	144	536

Chemical Examination of Water from Walden Pond, Lynn.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5528	Jan. 14	Jan. 15	V. sl't.	V. sl't.	1.00	4.25	2.20	.0012	.0194	.0178	.0016	.36	.0040	.0000	–
5649	Feb. 12	Feb. 13	Slight.	Cons.	1.20	4.30	2.10	.0000	.0246	.0170	.0076	.36	.0060	.0000	–
5769	Mar. 11	Mar. 12	Slight.	Slight.	0.90	4.60	1.75	.0002	.0262	.0182	.0080	.34	.0040	.0001	–
5883	Apr. 14	Apr. 16	Slight.	Cons.	0.45	–	–	.0004	.0206	.0156	.0050	.32	.0040	.0000	–
5987	May 14	May 16	Slight.	Slight.	0.80	–	–	.0022	.0196	.0164	.0032	.34	.0070	.0000	–
6092	June 18	June 19	Slight.	Slight.	0.90	–	–	.0094	.0258	.0234	.0024	.32	.0000	.0001	–
6238	July 15	July 16	Slight.	V. sl't	0.80	4.50	–	.0110	.0382	.0346	.0036	.34	.0000	.0001	1.3
6411	Aug. 14	Aug. 15	Slight.	Cons.	1.10	5.20	–	.0644	.0610	.0494	.0116	.35	.0050	.0002	0.9
6438	Aug. 25	Aug. 26	Dist't.	Cons.	1.30	–	–	.0576	.0746	.0560	.0186	.35	.0080	.0002	–
6439	Aug. 25	Aug. 26	Dist't.	Slight.	1.20	–	–	.0640	.0634	.0532	.0102	–	.0080	.0002	–
6520	Sept. 16	Sept. 17	Slight.	Cons.	1.30	–	–	.0126	.0766	.0562	.0204	.26	.0020	.0003	–
6591	Oct. 14	Oct. 15	V. sl't.	Slight.	1.40	5.70	3.25	.0526	.0552	.0498	.0054	.33	.0080	.0002	1.3
6712	Nov. 11	Nov. 12	V. sl't.	V. sl't.	1.60	5.55	2.90	.0940	.0642	.0540	.0102	.41	.0070	.0003	1.1
6804	Dec. 10	Dec. 11	V. sl't.	V sl't.	1.20	5.50	3.00	.0718	.0610	.0498	.0112	.36	.0200	.0001	0.9
Av.	....	....	....	....	1.06	4.98	2.53	.0292	.0432	.0351	.0081	.34	.0057	.0001	1.1

Odor, generally vegetable, frequently unpleasant, rarely none; when heated, the odor is much increased and frequently disagreeable. —— The samples were collected from the pond near the gatehouse, at a depth of one foot beneath the surface, with the exception of No. 6439, which was collected at about two feet above the bottom.

LYNN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.						
	Jan.	Feb.	Mar.	April.	May.	June.	July.
Day of examination,	16	15	14	16	17	24	16
Number of sample,	5528	5649	5769	5883	5987	6092	6238
PLANTS.							
Diatomaceæ,	**4**	**11**	**0**	**181**	**130**	**5**	**4**
Asterionella,	pr.	0	0	2	5	0	0
Melosira,	0	0	0	0	0	5	0
Stephanodiscus,	3	11	0	0	0	0	0
Synedra,	1	0	0	177	121	0	4
Tabellaria,	0	0	0	2	4	0	0
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Algæ,	**7**	**4**	**0**	**0**	**22**	**109**	**6**
Chlorococcus,	7	4	0	0	22	89	6
Closterium,	0	0	0	0	0	0	0
Cœlastrum,	0	0	0	0	0	20	0
Eudorina,	0	0	0	0	0	0	0
Sorastrum,	0	0	0	0	0	0	0
Staurastrum,	0	0	0	0	0	0	0
Fungi,	**0**	**7**	**12**	**7**	**9**	**14**	**19**
Crenothrix,	0	7	12	7	9	14	19
Leptothrix,	0	0	0	0	0	0	0
ANIMALS.							
Rhizopoda,	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Arcella,	0	0	0	0	0	0	0
Difflugia,	0	0	0	0	0	0	0
Infusoria,	**98**	**16**	**5**	**3**	**pr.**	**0**	**1**
Dinobryon,	98	16	1	pr.	pr.	0	1
Peridinium,	0	0	0	0	0	0	0
Synura,	0	0	4	3	0	0	0
Trachelomonas,	0	0	0	0	0	0	0
Vermes,	**0**	**0**	**0**	**pr.**	**0**	**pr.**	**6**
Anurea,	0	0	0	0	0	pr.	2
Asplanchna,	0	0	0	0	0	0	0
Monocerca,	0	0	0	0	0	0	0
Pedalion,	0	0	0	0	0	0	4
Polyarthra,	0	0	0	pr.	0	0	0
Crustacea,	**0**	**0**	**0**	**0**	**pr.**	**pr.**	**0**
Cyclops,	0	0	0	0	pr.	pr.	0
Daphnia,	0	0	0	0	0	0	0
Moina,	0	0	0	0	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	109	38	17	191	161	128	36

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.						
	Aug.	Aug	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	26	27	17	16	12	12
Number of sample,	6411	6438	6439	6520	6591	6712	6804
PLANTS.							
Diatomaceæ,	**0**	**4**	**2**	**2**	**26**	**8**	**4**
Asterionella,	0	0	0	0	3	0	2
Melosira,	0	0	0	2	0	8	2
Stephanodiscus,	0	0	1	0	9	0	0
Synedra,	0	4	0	0	0	0	pr.
Tabellaria,	0	0	1	0	0	0	0
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**14**	**0**	**0**
Algæ,	**102**	**424**	**203**	**1,033**	**75**	**0**	**0**
Chlorococcus,	14	0	56	3	56	0	0
Closterium,	56	5	0	0	0	0	0
Cœlastrum,	0	0	0	0	0	0	0
Eudorina,	8	120	0	636	0	0	0
Sorastrum,	10	292	146	356	19	0	0
Staurastrum,	14	7	1	38	0	0	0
Fungi,	**276**	**0**	**41**	**6**	**20**	**10**	**2**
Crenothrix,	276	0	0	6	20	10	2
Leptothrix,	0	0	41	0	0	0	0
ANIMALS.							
Rhizopoda,	**2**	**12**	**9**	**0**	**0**	**0**	**0**
Arcella,	0	12	9	0	0	0	0
Difflugia,	2	0	0	0	0	0	0
Infusoria,	**2**	**27**	**2**	**29**	**1**	**1**	**pr.**
Dinobryon,	0	0	0	0	0	0	0
Peridinium,	0	0	2	0	0	0	0
Synura,	0	0	0	0	0	0	0
Trachelomonas,	2	27	0	29	1	1	pr.
Vermes,	**0**	**19**	**12**	**2**	**0**	**0**	**0**
Anurea,	0	6	0	0	0	0	0
Asplanchna,	0	4	0	0	0	0	0
Monocerca,	0	0	0	2	0	0	0
Pedalion,	0	0	0	0	0	0	0
Polyarthra,	0	9	12	0	0	0	0
Crustacea,	**0**	**2**	**2**	**pr.**	**pr.**	**pr.**	**0**
Cyclops,	0	0	0	pr.	pr.	pr.	0
Daphnia,	0	0	0	0	pr.	pr.	0
Moina,	0	2	2	0	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**2**	**0**
TOTAL ORGANISMS,	382	488	271	1,072	136	21	6

LYNN.

Chemical Examination of Water from the Canal, Lynn Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	18	89.													
5376	Nov. 21	Nov. 22	V. sl't.	V. sl't.	1.3	5.20	2.70	.0000	.0228	.0220	.0008	.34	.0020	.0003	-

Odor, distinctly vegetable. —— The sample was collected from the canal which conveys water from Hawkes and Penny brooks to Birch Pond and the pumping-station.

Microscopical Examination.

Diatomaceæ, *Melosira*, pr.; *Navicula*, pr.; *Synedra*, 3. Fungi, *Crenothrix*, 15; *Leptothrix*, 1. Total organisms, 19.

Table Showing the Average Height of Water in the Ponds and Storage Reservoirs of the Lynn Water Works, during the Weeks in which Samples of Water were collected for Analysis.

Week Ending	Breed's Pond. High Water, 21.00.	Birch Pond. High Water, 21.75.	Walden Pond. High Water, 16.00.	Glen Lewis Pond. High Water, 16.00.
1889.				
June 17,	21.1	22.0	-	-
July 16,	18.6	21.7	-	-
Aug. 21,	20.0	20.3	-	-
Sept. 21,	19.0	18.0	-	-
Oct. 19,	16.1	18.0	-	-
Nov. 21,	16.1	18.7	-	-
Dec. 16,	19.6	20.3	-	-
1890.				
Jan. 20,	19.3	20.6	8.8	13.8
Feb. 12,	18.5	20.4	10.0	14.9
Mar. 12,	19.7	21.0	11.9	16.9
April 16,	20.9	22.0	16.2	17.3
May 14,	20.7	22.3	16.9	17.3
June 23,	20.0	22.7	17.1	17.2
July 21,	19.2	19.1	16.6	16.9
Aug. 18,	17.3	16.7	16.3	17.0
Aug. 25,	16.3	16.5	16.1	17.0
Sept. 15,	15.8	15.2	15.9	17.1
Sept. 22,	16.2	14.0	16.0	17.1
Oct. 20,	17.0	11.1	16.8	16.0
Nov. 17,	19.4	12.6	17.2	17.1
Dec. 15,	19.9	13.6	16.8	17.3

LYNNFIELD.

Chemical Examination of Water from Pilling's Pond, in Lynnfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4916	July 6	July 9	Slight.	V. sl't.	0.90	9.45	4.70	.0032	.0400	.0340	.0060	.33	.0030	.0001	-
4960	July 19	July 20	Dist't.	Slight.	0.70	-	-	.0010	.0400	.0324	.0076	-	.0050	.0001	-
5009	Aug. 2	Aug. 3	Slight.	V. sl't.	0.70	-	-	.0018	.0366	.0298	.0068	-	.0020	.0002	-
5086	Aug. 19	Aug. 21	Slight.	V. sl't.	0.80	-	-	.0016	.0386	.0310	.0076	-	.0080	.0000	3.6
5121	Aug. 30	Sept. 3	Dist't.	Slight.	0.90	-	-	.0016	.0366	.0290	.0076	-	.0040	.0000	-
5177	Sept. 13	Sept. 14	Slight.	Slight.	0.80	-	-	.0016	.0376	.0338	.0038	-	.0020	.0001	-
5200	Sept. 23	Sept. 25	Dist't.	Slight.	0.50	-	-	.0012	.0294	.0276	.0018	-	.0020	.0001	-
Av.	....	....	....	....	0.76	-	-	.0017	.0370	.0311	.0059	-	.0037	.0001	-

Odor, faintly vegetable.—— The samples were collected from the pond, near the outlet.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.						
	July.	July.	Aug.	Aug.	Sept.	Sept.	Sept.
Day of examination,	9	20	3	22	6	17	26
Number of sample,	4916	4960	5009	5086	5121	5177	5200
PLANTS.							
Diatomaceæ,	**0**	**0**	**0**	**pr.**	**1**	**9**	**pr.**
Melosira,	0	0	0	0	0	5	0
Synedra,	0	0	0	pr.	1	4	pr.
Algæ,	**5**	**0**	**8**	**21**	**25**	**10**	**4**
Characium,	0	0	8	18	12	10	4
Chlorococcus,	5	0	0	3	13	0	0
ANIMALS.							
Infusoria,	**19**	**0**	**0**	**2**	**2**	**pr.**	**1**
Ciliated infusorian,	6	0	0	0	0	0	0
Peridinium,	13	0	0	2	2	pr.	1
Vermes,	**pr.**	**3**	**0**	**pr.**	**0**	**0**	**pr.**
Polyarthra,	pr.	0	0	pr.	0	0	pr.
Rotatorian ova,	0	3	0	0	0	0	0
TOTAL ORGANISMS,	24	3	8	23	28	19	5

LYNNFIELD.

Chemical Examination of Water from Suntaug Lake, in Lynnfield.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.														
4571	Apr. 24	Apr. 26	V. sl't.	Slight.	0.00	3.70	1.30	.0036	.0240	.0202	.0038	.61	.0090	.0001	–
4715	May 22	May 23	Slight.	V. sl't.	0.00	3.40	1.05	.0024	.0176	.0126	.0050	.60	.0030	.0000	–
4875	June 23	June 25	V. sl't.	V. sl't.	0.00	3.45	0.80	.0010	.0160	.0152	.0008	–	.0030	.0000	–
4997	July 30	July 31	V. sl't.	Slight.	0.00	–	–	.0008	.0186	.0154	.0032	–	.0030	.0000	–
5091	Aug. 21	Aug. 22	Slight.	V. sl't.	0.02	–	–	.0000	.0182	.0140	.0042	–	.0030	.0000	1.8
5203	Sept. 26	Sept. 30	Slight.	Cons.	0.05	–	–	.0004	.0152	.0136	.0016	–	.0020	.0000	–
Av.	....	....	....	....	0.01	3.52	1.05	.0014	.0183	.0152	.0031	–	.0038	.0000	–

Odor, generally faintly vegetable, frequently disagreeable. —— The samples were collected from the lake.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889. April.	1889. May.	1889. June.	1889. Aug.	1889. Aug.	1889. Oct.
Day of examination,	27	23	25	1	22	1
Number of sample,	4571	4715	4875	4997	5091	5203
PLANTS.						
Diatomaceæ,	**41**	**18**	**2**	**5**	**0**	**63**
Melosira,	6	1	0	5	0	63
Stephanodiscus,	16	15	2	0	0	0
Synedra,	16	2	pr.	0	0	pr.
Tabellaria,	3	0	0	0	0	0
Cyanophyceæ,	**0**	**0**	**pr.**	**13**	**16**	**105**
Aphanocapsa,	0	0	0	0	0	7
Chroöcoccus,	0	0	pr.	0	0	81
Clathrocystis,	0	0	pr.	3	16	10
Cœlosphærium,	0	0	0	10	0	7
Algæ. Chlorococcus,	**0**	**0**	**0**	**3**	**12**	**10**
ANIMALS.						
Infusoria,	**120**	**0**	**pr.**	**5**	**63**	**pr.**
Dinobryon,	120	0	0	4	63	0
Peridinium,	0	0	pr.	1	0	pr.
TOTAL ORGANISMS,	161	18	2	26	91	178

WATER SUPPLY OF MALDEN, MEDFORD AND MELROSE.

Chemical Examination of Water from Spot Pond, Stoneham.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4802	June 6	June 7	Slight.	Slight.	0.30	–	–	.0000	.0212	.0190	.0022	.40	.0020	.0001	–
4908	July 3	July 5	Slight.	Cons.	0.20	–	–	.0070	.0328	.0242	.0086	–	.0080	.0001	–
5040	Aug. 7	Aug. 8	Slight.	Cons.	0.20	–	–	.0000	.0226	.0180	.0046	–	.0000	.0002	–
5145	Sept. 4	Sept. 6	Dist't.	Slight.	0.25	–	–	.0022	.0238	.0210	.0028	–	.0020	.0000	–
5227	Oct. 4	Oct. 6	Slight.	Slight.	0.30	–	–	.0022	.0220	.0196	.0024	–	.0020	.0000	–
5318	Nov. 6	Nov. 7	Slight	Slight.	0.30	–	–	.0000	.0274	.0222	.0052	–	.0100	.0002	–
5421	Dec. 4	Dec. 6	Slight.	Slight.	0.20	–	–	.0008	.0240	.0198	.0042	–	.0080	.0001	–
	1890.														
5518	Jan. 7	Jan. 9	V. sl't.	Slight.	0.35	–	–	.0006	.0210	.0154	.0056	–	.0040	.0001	–
5603	Feb. 6	Feb. 8	Slight.	Slight.	0.30	–	–	.0004	.0216	.0182	.0034	–	.0050	.0001	–
5747	Mar. 5	Mar. 5	Slight.	Slight.	0.30	–	–	.0000	.0174	.0148	.0026	.43	.0040	.0001	–
5789	Mar. 14	Mar. 16	V. sl't.	Slight.	0.40	–	–	–	–	–	–	.42	.0030	.0000	–
5813	Mar. 24	Mar. 25	Slight.	Slight.	0.40	–	–	.0002	.0212	.0182	.0030	.42	.0030	.0001	–
5857	Apr. 7	Apr. 9	Dist't.	Slight.	0.15	–	–	.0000	.0224	.0154	.0070	.44	.0030	.0000	–
5911	Apr. 24	Apr. 28	Slight	Cons.	0.20	–	–	.0010	.0198	.0182	.0016	.43	.0040	.0000	–
5950	May 6	May 8	Slight.	Slight.	0.10	–	–	.0008	.0246	.0200	.0046	.41	.0040	.0000	–
6048	June 5	June 7	Dist't.	Slight.	0.10	–	–	.0024	.0284	.0224	.0060	.43	.0020	.0003	–
6167	July 1	July 5	Slight.	Cons.	0.15	3.95	–	.0076	.0228	.0178	.0050	.39	.0100	.0000	1.6
6364	Aug. 4	Aug. 6	V. sl't.	Slight.	0.15	4.10	1.65	.0030	.0266	.0236	.0030	.42	.0040	.0001	2.3
6474	Sept. 3	Sept. 5	Slight.	Slight.	0.25	5.15	1.50	.0010	.0260	.0208	.0052	.44	.0080	.0000	1.6
6571	Oct. 8	Oct. 9	V. sl't.	Slight.	0.30	3.85	1.40	.0034	.0182	.0138	.0044	.42	.0150	.0000	1.3
6746	Nov. 21	Nov. 24	V. sl't.	V. sl't.	0.20	3.50	1.10	.0022	.0182	.0144	.0038	.45	.0150	.0000	1.8
6790	Dec. 4	Dec. 4	Slight.	Slight.	0.20	3.20	0.55	.0042	.0204	.0192	.0012	.46	.0200	.0001	1.7
Av.	....	....	....	....	0.23	3.96	1.24	.0020	.0233	.0191	.0042	.42	.0066	.0001	1.7

Odor, generally vegetable and disagreeable. —— The samples were collected from the pond near the Malden pumping-station.

MALDEN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.			
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Mar.
Day of examination,	10	5	8	7	8	9	10	11	8	7	18
Number of sample,	4802	4908	5040	5145	5227	5318	5421	5518	5603	5747	5789
PLANTS.											
Diatomaceæ,	**2**	**72**	**230**	**138**	**99**	**516**	**361**	**152**	**200**	**168**	**106**
Asterionella,	0	6	0	0	4	226	279	116	156	112	54
Melosira,	pr.	0	0	0	0	40	13	0	0	0	0
Navicula,	0	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	0	pr.	1	0	pr.	9	14	17	25	34	37
Synedra,	0	6	1	2	pr.	1	pr.	4	5	5	3
Tabellaria,	2	60	228	136	95	240	55	15	12	17	10
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**
Algæ,	**0**	**5**	**15**	**9**	**33**	**30**	**10**	**8**	**3**	**0**	**0**
Chlorococcus,	0	5	15	9	28	26	8	8	3	0	0
Raphidium,	0	0	0	0	3	4	0	0	0	0	0
Zoöspores,	0	0	0	0	2	0	2	0	2	0	2
ANIMALS.											
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**pr.**	**34**	**54**	**26**	**6**	**10**	**2**	**1**	**pr.**	**2**	**38**
Dinobryon,	pr.	0	0	0	6	8	1	pr.	0	0	0
Monas,	0	0	0	0	0	0	0	pr.	0	0	36
Peridinium,	pr.	34	54	26	0	pr.	1	pr.	pr.	0	pr.
Synura,	0	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	pr.	0	pr.	0	2	0	0	0	0	0
Uroglena,	0	0	0	0	0	0	0	1	0	2	2
Vermes,	**0**	**pr.**	**pr.**	**pr.**	**3**	**0**	**0**	**0**	**0**	**0**	**0**
Anurea,	0	0	pr.	pr.	pr.	0	0	0	0	0	0
Polyarthra,	0	pr.	0	0	3	0	0	0	0	0	0
Crustacea,	**0**	**pr.**	**pr.**	**0**	**pr.**	**0**	**0**	**0**	**0**	**pr.**	**0**
Cyclops,	0	pr.	pr.	0	pr.	0	0	0	0	0	0
Daphnia,	0	0	0	0	0	0	0	0	0	pr.	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	2	111	299	173	141	556	373	161	213	170	144

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.										
	Mar	April	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	9	29	8	7	8	6	6	9	24	6
Number of sample,	5813	5857	5911	5950	6048	6167	6364	6474	6571	6746	6790
PLANTS.											
Diatomaceæ,	**109**	**105**	**120**	**77**	**161**	**88**	**25**	**141**	**90**	**135**	**173**
Asterionella,	45	42	12	7	60	5	0	0	0	42	49
Melosira,	0	0	18	0	0	5	14	70	32	47	50
Navicula,	0	0	0	pr.	0	0	1	1	2	6	2
Stephanodiscus,	8	11	8	4	26	7	1	0	6	11	49
Synedra,	23	26	48	5	3	7	0	4	6	18	14
Tabellaria,	32	21	34	61	72	64	9	66	44	11	9
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**9**	**0**	**10**	**9**
Algæ,	**1**	**12**	**8**	**pr.**	**5**	**19**	**0**	**6**	**12**	**4**	**11**
Chlorococcus,	0	7	5	pr.	5	19	0	1	12	0	0
Raphidium,	0	0	3	0	0	0	0	5	0	4	11
Zoöspores,	1	5	0	0	0	0	0	0	0	0	0
ANIMALS.											
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**34**	**15**
Infusoria,	**30**	**9**	**pr.**	**13**	**4**	**11**	**33**	**11**	**4**	**0**	**1**
Dinobryon,	21	pr.	0	0	0	9	0	1	2	0	0
Monas,	0	0	0	6	3	0	0	0	0	0	0
Peridinium,	2	4	0	1	0	2	32	10	0	0	1
Synura,	0	0	0	5	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	pr.	1	pr.	1	0	2	0	0
Uroglena,	7	5	pr.	1	0	0	0	0	0	0	0
Vermes,	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**0**
Anurea,	0	0	0	0	1	2	0	0	0	0	0
Polyarthra,	0	0	0	0	1	0	0	0	0	0	0
Crustacea,	**0**	**0**	**pr.**	**0**	**pr.**	**0**	**0**	**2**	**0**	**0**	**pr.**
Cyclops,	0	0	pr.	0	0	0	0	0	0	0	pr.
Daphnia,	0	0	0	0	pr.	0	0	2	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
TOTAL ORGANISMS,	140	126	128	90	173	120	67	170	106	183	209

MALDEN.

Table showing Heights of Water in Spot Pond at the Times when Samples of Water were collected for Analysis.

NOTE.—Heights are in feet above or below high-water mark. The sign + indicates "above high water." The sign — indicates "below high water."

DATE.	Height of Water.	DATE.	Height of Water.
1889.		**1890**—Con.	
June 6,	0.0	Mar. 24,	+0.2
July 3,	—0.6	April 7,	+0.1
Aug. 7,	—0.6	April 24,	0.0
Sept. 4,	—0.8	May 6,	0.0
Oct. 4,	—1.2	June 5,	0.0
Nov. 6,	—1.1	July 1,	—0.5
Dec. 4,	—0.1	Aug. 4,	—1.7
1890.		Sept. 3,	—2.4
Jan. 7,	0.0	Oct. 8,	—3.1
Feb. 6,	0.0	Nov. 21,	—2.4
Mar. 5,	+0.1	Dec. 4,	—2.4
Mar. 14,	+0.1		

WATER SUPPLY OF MALDEN.

Chemical Examination of Water from Tubular Wells at Webster Park (Eaton's Meadows), Malden.

[Parts per 100,000.]

	DATE OF		APPEARANCE.				AMMONIA.			NITROGEN AS		
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.											
4801	June 6	June 7	Very slight.	None.	0.0	17.10	.0000	.0006	1.45	.5500	.0000	–
5283	Oct. 25	Oct. 26	Very slight.	Consid'able.	0.0	16.80	.0002	.0056	2.04	.5500	.0001	7.3
	1890.											
5602	Feb. 6	Feb. 7	None.	None.	0.0	17.10	.0000	.0004	2.30	.5000	.0000	–
5746	Mar. 4	Mar. 5	None.	None.	0.0	–	.0000	.0008	2.20	.3500	.0000	–
5858	Apr. 7	Apr. 9	None.	None.	0.0	–	.0004	.0012	2.25	.5000	.0001	–
5912	Apr. 24	Apr. 28	None.	None.	0.0	–	.0000	.0020	2.39	.4500	.0001	8.6
5913	Apr. 24	Apr. 28	None.	Very slight.	0.0	–	.0004	.0018	2.36	.4500	.0001	8.1
6049	June 5	June 7	None.	None.	0.0	–	.0008	.0012	2.35	.4100	.0002	–
6168	July 1	July 5	None.	None.	0.0	18.00	.0002	.0016	2.29	.5500	.0001	9.0
6365	Aug. 4	Aug. 6	None.	None.	0.0	18.65	.0008	.0020	2.15	.4250	.0000	8.3
6475	Sept. 3	Sept. 5	None.	Very slight.	0.0	19.25	.0002	.0016	2.40	.6250	.0001	7.3
6570	Oct. 6	Oct. 9	None.	None.	0.0	17.90	.0000	.0014	2.25	.5500	.0001	7.1
6700	Nov. 4	Nov. 8	None.	None.	0.0	18.70	.0000	.0004	2.35	.4500	.0001	7.7
6791	Dec. 4	Dec. 4	None.	None.	0.0	17.70	.0000	.0024	2.31	.6250	.0001	8.0
Av.	....	....	....	....	0.0	17.91	.0002	.0016	2.21	.5027	.0001	7.9

Odor, none.——The samples were collected from a faucet in the pumping-station at Eaton's Meadows, with the exception of No. 4801, which was collected from a tubular test well in the vicinity of the other wells, and No. 5913, which was collected from a faucet about half a mile from the pumping-station.

Microscopical Examination.

No organisms.

MALDEN.

Chemical Examination of Water from Doleful Pond, Stoneham.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1890.														
6699	Aug. 4	Aug. 8	V. sl't.	V. sl't.	2.20	8.50	–	.0010	.0330	–	–	.66	.0050	.0002	2.2

Odor, vegetable.——The sample was collected from the brook which flows from Doleful Pond into Spot Pond.

Microscopical Examination.

Diatomaceæ, *Melosira*, 4; *Meridion*, 7; *Navicula*, 10; *Synedra*, 3; *Tabellaria*, 3. Cyanophyceæ, *Microcystis*, pr. Algæ, *Cosmarium*, 2; *Scenedesmus*, 1; *Staurastrum*, pr. Fungi, *Crenothrix*, 8. Infusoria, *Trachelomonas*, 1. Porifera, *Sponge spicules*, 4. Total organisms, 43.

MANCHESTER.

Chemical Examination of Water from Saw Mill Brook in Manchester.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1890.														
6635	Oct. 22	Oct. 23	None.	V. sl't.	2.50	8.05	4.65	.0006	.0268	.0256	.0012	0.98	.0100	.0001	1.1

Odor, vegetable.——The sample was collected from Saw Mill Brook, about 150 feet above the junction with the brook coming from the brick yard.

Microscopical Examination.

Diatomaceæ, *Tabellaria*, 2. Cyanophyceæ, *Oscillaria*, pr. Total organisms, 2.

Chemical Examination of Water from the Nat. Allen Spring and a Tubular Well near Saw Mill Brook in Manchester.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6636	Oct. 22	Oct. 23	None.	None.	0.00	8.70	.0000	.0000	1.50	.3000	.0000	2.7
6637	Oct. 22	Oct. 23	None.	V. slight.	0.00	8.10	.0000	.0012	1.27	.2900	.0000	2.6

Odor, none.—— Sample No. 6636 was collected from the well; No. 6637 from the Nat. Allen Spring.

Microscopical Examination.

No organisms in either sample.

NOTE.—The samples from Manchester were collected during an investigation with reference to obtaining a water supply for the town.

MARBLEHEAD.

WATER SUPPLY OF MARBLEHEAD.

Description of Works. — Population in 1890, 8,202. Water was first introduced into the town in 1887. The distributing system was owned by the town and the water was purchased from the Marblehead Water Company, the source being located in the town of Swampscott. At that time only a portion of the town was supplied with water. In 1889 the town of Marblehead obtained authority from the legislature to take an independent supply from sources in the southerly part of Salem.

Some test wells were driven near the edge of the marsh near Loring Avenue in Salem, a short distance westerly from the mouth of Forest River; and the advice of the State Board of Health was sought with reference to obtaining a ground water supply at this place. The Board, after making careful examinations of the locality and an analysis of the water, replied that the quality of the water flowing from test wells at this place was excellent, except that it was somewhat harder than was desirable, but that the quantity of water which could be obtained from this source would not be sufficient for the supply of the town. Notwithstanding this advice the town proceeded with the construction of works for obtaining a supply from this source. A tide-gate was constructed at the mouth of Forest River to keep the salt water from backing up into the river and flowing over the marsh in the vicinity of the wells. About forty tubular wells were driven in and near the marsh lying between the original flowing test wells and the tide-gate. Those nearest the tide-gate were driven to a depth of between 45 and 50 feet, while those further away are not so deep. The wells were connected with a temporary pump and beginning Oct. 1, 1889, water was pumped from them to the town and to an open iron tank 30 feet in diameter and 100 feet in height. In the summer of 1890, when the maximum daily consumption was said to have been 350,000 gallons, it was found that the water from the wells was becoming salt and hard, and several of those most affected were discontinued. In September, 1890, the construction of a large well was begun near the location of the original test wells and as far from the tide-gate as it is practicable to locate a well in the low land. This well is 30 feet in diameter and 34 feet in depth. The lining is of brick work, 12 inches in thickness, excepting the lower three feet, which is lined with stone work laid without mortar. The distributing mains are of cast iron and the service pipes are of galvanized iron.

MARBLEHEAD.

Chemical Examination of Water from Tubular Wells of the Marblehead Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1889.											
3604	Nov. 23	Nov. 24	None.	None.	0.00	9.65	.0000	.0008	1.25	.1250	.0000	–
	1890.											
6416	Aug. 18	Aug. 19	Slight.	Consider'ble.	0.00	16.80	.0120	.0022	3.40	.0150	.0001	7.7
6417	Aug. 18	Aug. 19	Slight.	Sl't, earthy.	0.00	12.60	.0000	.0014	1.78	.1100	.0000	6.4
6484	Sept. 8	Sept. 9	Slight.	Slight.	0.00	25.35	.0070	.0004	1.47	.0950	.0001	16.7
6757	Nov. 24	Nov. 25	Distinct.	Very slight.	0.00	110.60	.0186	.0014	43.46	.0150	.0005	47.1

Odor, none. —— Sample No. 3604 was collected from a flowing tubular test well before the works were constructed. No. 6416 was collected from a tubular well about 500 feet south-west of the temporary pumping-station. No. 6417 was collected from a tubular well about 1,000 feet south-west of the temporary pumping-station.* No. 6484 was collected from a faucet in the temporary pumping-station. No. 6757 was collected from a faucet in the temporary pumping-station while pumping from 14 tubular wells, 5 being in the vicinity of the pumping-station and 9 at a considerable distance up the valley.

Microscopical Examination.

No. 3604. No organisms. No. 6416. Fungi, *Crenothrix*, 54. No. 6417. Algæ, *Arthrodesmus*, pr.; *Scenedesmus*, pr. No. 6484. No organisms. No. 6757. No organisms.

Chemical Examination of Water from Forest River in Salem.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6758	Nov. 24	Nov. 25	Slight.	Slight.	0.75	9.60	2.30	.0022	.0270	.0236	.0034	2.05	.0100	.0001	3.6

Odor, musty and disagreeable.—— The sample was collected from the river, near the temporary pumping-station of the Marblehead Water Works.

Microscopical Examination.

Diatomaceæ, *Gonphonema*, 2; *Meridion*, 4; *Navicula*, 15; *Synedra*, 3. Fungi, *Crenothrix*, 13. Rhizopoda, *Actinophrys*, 3. Total organisms, 40.

MARLBOROUGH.

WATER SUPPLY OF MARLBOROUGH.

Chemical Examination of Water from Lake Williams, Marlborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved	Suspended.				
	1889.														
4866	June 21	June 22	Slight.	Slight.	0.05	–	–	.0008	.0270	.0184	.0086	.45	.0020	.0000	–
4936	July 11	July 12	Slight.	Cons.	0.10	–	–	.0000	.0294	.0246	.0048	–	.0000	.0000	–
5072	Aug. 16	Aug. 17	Dist't.	Slight.	0.00	–	–	.0010	.0276	.0224	.0052	–	.0020	.0001	–
5169	Sept. 12	Sept. 12	Slight.	Slight.	0.03	–	–	.0022	.0266	.0228	.0038	–	.0040	.0001	–
5246	Oct. 10	Oct. 11	V. sl't.	Slight.	0.00	–	–	.0008	.0208	.0182	.0026	–	.0080	.0000	–
5375	Nov. 21	Nov. 22	V. sl't.	V. sl't.	0.10	–	–	.0002	.0190	.0180	.0010	–	.0070	.0000	–
5439	Dec. 12	Dec. 13	Slight.	Slight.	0.00	–	–	.0002	.0162	.0140	.0022	–	.0060	.0001	–
	1890.														
5536	Jan. 16	Jan. 17	Dist't.	Slight.	0.05	–	–	.0000	.0186	.0148	.0038	–	.0100	.0001	–
5663	Feb. 13	Feb. 14	Slight.	V. sl't.	0.03	–	–	.0000	.0184	.0154	.0030	–	.0100	.0001	–
5788	Mar. 14	Mar. 15	Slight.	Slight.	0.10	–	–	.0000	.0218	.0168	.0050	.49	.0100	.0000	–
5879	Apr. 11	Apr. 12	V. sl't.	Slight.	0.03	–	–	.0004	.0172	.0142	.0030	.46	.0180	.0000	–
5991	May 16	May 17	V. sl't.	V. sl't.	0.00	–	–	.0020	.0218	.0164	.0054	.45	.0000	.0000	–
6110	June 20	June 21	Dist't.	Slight.	0.00	–	–	.0024	.0270	.0178	.0092	.43	.0020	.0000	2.3
6211	July 11	July 14	Slight.	Slight.	0.03	4.35	–	.0028	.0208	.0166	.0042	.44	.0000	.0001	2.3
6432	Aug. 21	Aug. 22	V. sl't.	V. sl't.	0.00	4.30	1.50	.0000	.0204	.0180	.0024	.47	.0040	.0000	2.5
6507	Sept. 11	Sept. 12	Slight.	V. sl't.	0.05	4.80	0.80	.0002	.0210	.0174	.0036	.47	.0030	.0000	2.5
6580	Oct. 9	Oct. 10	V. sl't.	V. sl't.	0.00	4.65	1.40	.0000	.0190	.0164	.0026	.45	.0050	.0000	2.2
6728	Nov. 14	Nov. 15	V. sl't.	V. sl't.	0.02	3.85	0.80	.0002	.0198	.0164	.0034	.49	.0200	.0001	2.1
6792	Dec. 5	Dec. 6	V. sl't.	V. sl't.	0.03	4.45	1.15	.0002	.0212	.0182	.0030	.48	.0120	.0001	2.1
Av.	....	....	....	....	0.03	4.41	1.13	.0007	.0218	.0177	.0041	.46	.0065	.0000	2.3

Odor, vegetable, and frequently disagreeable. —— The samples were collected from a faucet at the pumping-station, while pumping.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	22	12	20	12	12	23	14	18	15
Number of sample,	4866	4936	5072	5169	5246	5375	5439	5536	5663
PLANTS.									
Diatomaceæ,	**23**	**24**	**129**	**18**	**183**	**194**	**203**	**162**	**579**
Asterionella,	0	0	4	2	164	37	13	9	21
Synedra,	1	2	1	2	6	8	5	9	2
Tabellaria,	22	22	124	14	13	149	185	144	556
Cyanophyceæ,	**70**	**96**	**pr.**	**2**	**0**	**0**	**0**	**0**	**0**
Anabæna,	0	14	0	0	0	0	0	0	0
Chroöcoccus,	70	74	0	0	0	0	0	0	0
Cœlosphærium,	pr.	8	pr.	2	0	0	0	0	0
Algæ,	**50**	**47**	**33**	**8**	**3**	**5**	**4**	**0**	**0**
Chlorococcus,	50	47	28	8	3	5	0	0	0
Cœlastrum,	0	pr.	0	0	0	0	0	0	0
Raphidium,	0	0	5	0	0	0	4	0	0

MARLBOROUGH.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
ANIMALS.									
Infusoria,	pr.	pr.	2	pr.	19	10	0	7	6
Ceratium,	pr.	0	0	pr.	0	0	0	0	0
Dinobryon,	0	0	2	0	18	8	0	7	2
Monas,	0	0	0	0	0	0	0	0	2
Peridinium,	0	0	0	0	1	2	0	0	1
Trachelomonas,	pr.	pr.	pr.	0	0	0	0	0	1
Vermes. Anurea,	0	pr.	0	0	1	pr.	0	0	0
TOTAL ORGANISMS,	143	167	164	28	206	209	207	169	585

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	15	20	25	15	25	15	11	17	6
Number of sample,	5788	5879	5991	6110	6211	6432	6507	6580	6728	6792
PLANTS.										
Diatomaceæ,	228	463	317	25	170	20	13	22	129	286
Asterionella,	40	15	0	0	98	6	0	22	86	236
Synedra,	5	9	4	15	48	0	1	0	35	0
Tabellaria,	183	439	313	10	24	14	12	0	8	50
Cyanophyceæ,	0	0	0	0	0	29	0	0	0	0
Anabæna,	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	29	0	0	0	0
Cœlosphærium,	0	0	0	0	0	0	0	0	0	0
Algæ,	2	2	12	305	228	0	0	3	0	0
Chlorococcus,	2	2	12	279	227	0	0	0	0	0
Cœlastrum,	0	0	0	26	1	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	0	3	0	0
ANIMALS.										
Infusoria,	11	26	5	25	1	7	1	133	0	0
Ceratium,	0	0	0	2	0	pr.	0	0	0	0
Dinobryon,	9	24	3	23	0	7	1	133	0	0
Monas,	0	0	2	0	0	0	0	0	0	0
Peridinium,	2	2	0	0	0	pr.	0	0	0	0
Trachelomonas,	0	0	pr.	0	1	0	0	0	0	0
Vermes. Anurea,	pr.	0	0	pr.	0	0	0	0	0	0
TOTAL ORGANISMS,	241	491	334	355	399	56	14	158	129	286

MARSHFIELD.

WATER SUPPLY OF BRANT ROCK, MARSHFIELD.

This is a small supply which furnishes water in summer to the cottages on the sea-shore in Brant Rock and the adjacent village of Abington. The source of supply is a tubular well 1¼ inches in diameter and 27 feet deep; located under the Atlantic House, and distant a little over 100 feet from high-water mark on the beach. The well was first used as a source of public water supply in 1888, though it had been in use for several years previously. Water is pumped from the well by wind power to two covered wooden tanks, one located near the well and one on a hill at a considerable distance back from the shore. The first tank is 7.4 feet in diameter and 7 feet in depth, and is supported by a tower 36 feet in height. The second tank is located on much higher ground and is considerably larger, being 14 feet in diameter and 13 feet in depth; it is supported by a tower 23 feet in height. The distributing pipes are very small, the largest being 2 inches in diameter.

Chemical Examination of Water from a Tubular Well at the Atlantic House, Brant Rock, Marshfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	89.										
5334	Nov. 11	Nov. 12	None.	None.	0.00	35.70	.0002	.0008	14.03	.0750	.0004	–

Odor, none.——The sample was collected from a faucet at the Atlantic House.

Microscopical Examination.

No organisms.

WATER SUPPLY OF MEDFORD. [See *Malden*.]

WATER SUPPLY OF MELROSE. [See *Malden*.]

WATER SUPPLY OF THE STATE PRIMARY SCHOOL, MONSON.

Chemical Examination of Water from the West Reservoir, at the State Primary School, Monson.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
6389	Aug. 11	Aug. 13	Dec'd.	Heavy.	0.50	4.00	1.50	.0064	.0108	.0048	.0060	.20	.0125	.0000	1.8
6390	Aug. 11	Aug. 13	Dec'd.	Heavy.	0.65	4.00	1.50	.0056	.0118	.0046	.0072	.20	.0150	.0000	1.8
6751	Nov. 22	Nov. 25	-	-	-	-	-	-	-	-	-	.15	.0100	.0001	-
6752	Nov. 22	Nov. 25	-	-	-	-	-	-	-	-	-	.16	.0300	.0003	-
6753	Nov. 22	Nov. 25	-	-	-	-	-	-	-	-	-	.18	.0200	.0001	-
6754	Nov. 22	Nov. 25	-	-	-	-	-	-	-	-	-	.18	.0300	.0001	-

Odor, vegetable. —— Samples numbered 6389 and 6390 were collected from a faucet at the school buildings supplied from the West Reservoir. No. 6751 was collected from the brook which feeds the West Reservoir just below the second road crossing above the reservoir ; No. 6752 from the brook just below the first road crossing above the reservoir; No. 6753 from the brook as it enters the reservoir; No. 6754 from the reservoir at the outlet.

Microscopical Examination.

No. 6389. Diatomaceæ, *Navicula*, 2; *Cyclotella*, 1; *Synedra*, 1,000.* Algæ, *Scenedesmus*, 3; *Staurastrum*, 1. Fungi, *Crenothrix*, 13. Infusoria, *Peridinium*, 2. Total organisms, 1,022.

No. 6390. Diatomaceæ, *Synedra*, 900.* Cyanophyceæ, *Nostoc*, 2. Algæ, *Chlorococcus*, 1; *Scenedesmus*, 3. Fungi, *Crenothrix*, 11. Infusoria, *Monas*, pr.; *Trachelomonas*, pr. Total organisms, 917.

WATER SUPPLY OF TURNER'S FALLS FIRE DISTRICT, MONTAGUE.

Chemical Examination of Water from Lake Pleasant, Montague.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
4839	June 14	June 15	V. sl't.	V. sl't.	00.0	2.10	0.50	.0000	.0082	.0070	.0012	-	.0060	.0000	-

Odor, none. —— The sample was collected from a faucet in the village of Turner's Falls.

Microscopical Examination.

Diatomaceæ, *Melosira*, pr.; *Synedra*, pr.; *Tabellaria*, pr. Algæ, *Desmidium*, pr.; *Euastrum*, pr. Fungi, *Crenothrix*, pr.

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* Estimated.

NANTUCKET.

WATER SUPPLY OF NANTUCKET. — WANNACOMET WATER COMPANY.

Chemical Examination of Water from Wannacomet Pond, Nantucket.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5193	Sept. 19	Sept. 21	Dec'd.	Slight.	0.20	–	–	.0058	.0576	.0364	.0212	1.99	.0020	.0000	–
5194	Sept. 19	Sept. 21	Dist't.	V sl't.	0.25	–	–	.0016	.0362	.0268	.0094	1.98	.0030	.0002	–
5204	Sept. 30	Oct. 1	Dec'd.	Cons.	0.20	–	–	.0006	.0508	.0296	.0212	–	.0040	.0000	–
5247	Oct. 10	Oct. 12	Dist't.	Slight.	0.10	–	–	.0030	.0462	.0318	.0144	–	.0030	.0001	–
5278	Oct. 23	Oct. 25	Dist't.	V. sl't.	0.05	–	–	.0036	.0402	.0238	.0164	–	.0050	.0001	–
5352	Nov. 14	Nov. 16	Dist't.	Cons.	0.00	–	–	.0034	.0334	.0220	.0114	–	.0040	.0001	–
	1890.														
5816	Mar. 24	Mar. 26	Dist't.	Slight.	0.00	–	–	.0008	.0190	.0116	.0074	1.91	.0020	.0000	–
5916	Apr. 28	Apr. 30	Slight.	Slight.	0.00	–	–	.0004	.0186	.0138	.0048	1.99	.0030	.0000	–

Odor, vegetable, and in the samples of 1889 also disagreeable. —— The samples were collected from a faucet in the pumping-station while pumping, with the exception of No. 5194, which was collected from a faucet on Hussey Street, in the town, where the circulation through the pipes is slight. There was much complaint of a disagreeable taste and odor in the water in the autumn of 1889.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.						1890.	
	Sept.	Sept.	Oct.	Oct.	Oct.	Nov.	Mar.	April.
Day of examination,	21	21	1	12	26	16	26	30
Number of sample,	5193	5194	5204	5247	5278	5352	5816	5916
PLANTS.								
Diatomaceæ,	**0**	**0**	**0**	**0**	**72**	**0**	**4,004**	**480**
Melosira,	0	0	0	0	72	0	0	0
Navicula,	0	0	0	0	0	0	4	0
Synedra,	0	0	0	0	0	0	4,000*	480*
Cyanophyceæ,	**1,280**	**676**	**1,192**	**1,304**	**992**	**360**	**9**	**0**
Anabæna,	1,280	676	1,192	1,304	992	80	0	0
Chroöcoccus,	0	0	0	0	0	0	9	0
Nostocaceous spores,	0	0	0	0	0	280	0	0
Algæ,	**1**	**0**	**0**	**2**	**14**	**30**	**26**	**0**
Chlorococcus,	0	0	0	0	14	24	25	0
Scenedesmus,	1	0	0	2	0	0	1	0
Staurastrum,	0	0	0	0	0	6	0	0
ANIMALS.								
Infusoria,	**40**	**13**	**18**	**16**	**12**	**4**	**204**	**14**
Ciliated infusorian,	0	0	0	4	0	0	0	0
Dinobryon,	0	0	0	0	0	0	204	14
Trachelomonas,	40	13	18	12	12	4	0	0
Vermes,	**0**	**0**	**0**	**0**	**2**	**12**	**0**	**3**
Anurea,	0	0	0	0	0	8	0	0
Monocerca,	0	0	0	0	2	0	0	0
Rotatorian ova,	0	0	0	0	0	4	0	0
Rotifer,	0	0	0	0	0	0	0	3
TOTAL ORGANISMS,	1,321	689	1,210	1,322	1,092	406	4,243	497

* Estimated.

Water Supply of Natick.

Chemical Examination of Water from Dug Pond, Natick.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4783	June 4	June 5	Slight.	V. sl't.	0.05	–	–	.0022	.0280	.0224	.0056	.68	.0300	.0006	–
4897	July 1	July 2	Dist't.	Slight.	0.05	–	–	.0020	.0250	.0250	.0000	–	.0300	.0001	–
5023	Aug. 5	Aug. 6	Dist't.	Cons.	0.10	–	–	.0010	.0366	.0242	.0124	–	.0030	.0003	–
5125	Sept. 3	Sept. 4	Dist't.	Cons.	0.05	–	–	.0000	.0280	.0234	.0046	–	.0050	.0000	–
5126	Sept. 3	Sept. 4	Dist't.	Cons.	0.10	–	–	.0046	.0276	.0226	.0050	–	.0050	.0000	–
5222	Oct. 2	Oct. 4	Slight.	Slight.	0.15	–	–	.0032	.0268	.0226	.0042	–	.0030	.0002	–
5302	Nov. 4	Nov. 5	Slight.	V. sl't.	0.25	–	–	.0184	.0238	.0190	.0048	–	.0070	.0004	–
5390	Dec. 2	Dec. 3	Slight.	V. sl't	0.15	–	–	.0158	.0224	.0184	.0040	–	.0170	.0004	–
	1890.														
5490	Jan. 2	Jan. 3	Slight.	V. sl't.	0.05	–	–	.0018	.0180	.0164	.0016	–	.0130	.0001	–
5585	Feb. 3	Feb. 4	Dist't.	V. sl't.	0.25	–	–	.0048	.0166	.0116	.0050	–	.0150	.0004	–
5736	Mar. 3	Mar. 4	Slight.	V. sl't.	0.35	–	–	.0030	.0160	.0150	.0010	.82	.0300	.0002	–
5842	Apr. 1	Apr. 2	Slight.	V. sl't.	0.20	–	–	.0032	.0162	.0162	.0000	.69	.0200	.0003	–
5934	May 1	May 2	V. sl't.	Slight.	0.03	–	–	.0016	.0206	.0162	.0044	.69	.0280	.0004	–
6035	June 2	June 4	Slight.	Slight.	0.20	–	–	.0030	.0162	.0144	.0018	.68	.0320	.0002	–
6161	July 1	July 2	Dec'd.	V. sl't.	0.02	5.75	–	.0024	.0250	.0186	.0064	.69	.0120	.0002	2.6
6352	Aug. 4	Aug. 5	Dist't.	Cons.	0.00	5.55	1.75	.0002	.0324	.0230	.0094	.70	.0100	.0002	2.5
6463	Sept. 2	Sept. 3	Slight.	Slight.	0.00	6.20	1.25	.0006	.0238	.0206	.0032	.75	.0070	.0001	2.5
6546	Oct. 1	Oct. 2	None.	V. sl't.	0.00	5.45	1.20	.0000	.0166	.0130	.0036	.70	.0150	.0001	2.6
6682	Nov. 3	Nov. 4	V. sl't.	V. sl't.	0.30	6.05	1.30	.0058	.0174	.0170	.0004	.72	.0400	.0003	3.2
6775	Dec. 1	Dec. 2	Slight.	V. sl't.	0.30	6.00	1.30	.0062	.0196	.0174	.0022	.71	.0500	.0002	3.0
Av.	....	....	....	....	0.13	5.85	1.36	.0041	.0226	.0186	.0040	.71	.0193	.0002	2.7

Odor, vegetable, frequently unpleasant, occasionally none. — The samples were collected from a faucet in the pumping-station while pumping, with the exception of Nos. 4783, 5023 and 5125, which were collected from the pond. No. 4783 was collected 4 feet beneath the surface; No. 5023 was collected from near the middle of the pond 1 foot beneath the surface; and No. 5125 was collected from the pond near the brook which feeds it.

NATICK.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.								1890.	
	June.	July.	Aug.	Sept.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	10	2	6	6	6	3	-	3	4	5
Number of sample,	4783	4897	5023	5125	5126	5222	5302	5390	5490	5585
PLANTS.										
Diatomaceæ,	**5**	**12**	**27**	**7**	**5**	**42**	**69**	**358**	**505**	**346**
Asterionella,	1	2	0	0	2	pr.	37	57	315	192
Melosira,	0	6	23	0	1	28	16	207	146	9
Stephanodiscus,	4	4	4	7	2	5	16	91	41	114
Synedra,	0	0	pr.	0	pr.	9	0	3	3	31
Cyanophyceæ,	**4**	**53**	**42**	**18**	**3**	**24**	**0**	**21**	**147**	**380**
Aphanocapsa,	4	0	0	0	0	0	0	20	147	380
Chroöcoccus,	0	49	0	3	0	17	0	0	0	0
Clathrocystis,	0	4	42	13	1	2	0	1	0	0
Cœlosphærium,	0	0	0	2	2	5	0	0	0	0
Algæ,	**18**	**24**	**24**	**122**	**113**	**114**	**pr.**	**55**	**0**	**2**
Chlorococcus,	18	24	24	120	113	99	0	51	0	2
Cœlastrum,	0	0	0	2	0	14	0	2	0	0
Scenedesmus,	0	0	0	0	0	1	pr.	2	0	0
ANIMALS.										
Infusoria,	**pr.**	**0**	**pr.**	**2**	**pr.**	**27**	**62**	**6**	**0**	**0**
Ceratium,	0	0	0	0	0	pr.	0	0	0	0
Dinobryon,	pr.	0	0	2	0	27	62	6	0	0
Peridinium,	0	0	pr.	0	0	0	0	0	0	0
Trachelomonas,	pr.	0	0	pr.	pr.	0	0	0	0	0
Vermes. Anurea,	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**
Crustacea. Cyclops,	**0**	**pr.**	**0**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	27	89	93	149	121	207	131	440	652	728

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	5	3	7	2	6	3	2	4	3
Number of sample,	5736	5842	5934	6035	6161	6352	6463	6546	6682	6775
PLANTS.										
Diatomaceæ,	**176**	**212**	**316**	**2**	**112**	**15**	**36**	**26**	**192**	**806**
Asterionella,	81	70	3	0	0	0	1	11	pr.	72
Melosira,	7	41	16	0	84	10	34	11	185	720
Stephanodiscus,	48	98	280	2	28	0	0	0	0	2
Synedra,	40	3	17	0	0	5	1	4	7	12
Cyanophyceæ,	**0**	**0**	**0**	**0**	**24**	**30**	**108**	**32**	**0**	**0**
Aphanocapsa,	0	0	0	0	16	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	104	31	0	0
Clathrocystis,	0	0	0	0	0	29	3	1	0	0
Cœlosphærium,	0	0	0	0	8	1	1	0	0	0
Algæ,	**3**	**0**	**3**	**80**	**1,556**	**292**	**15**	**4**	**2**	**0**
Chlorococcus,	3	0	2	80	1,504	292	11	1	2	0
Cœlastrum,	0	0	0	0	52	pr.	0	0	0	0
Scenedesmus,	0	0	1	0	0	pr.	4	3	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.										
Infusoria,	0	1	55	0	74	0	4	0	12	pr.
Ceratium,	0	0	0	0	8	0	0	0	0	0
Dinobryon,	0	1	53	0	66	0	1	0	12	pr.
Peridinium,	0	0	2	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	3	0	0	pr.
Vermes. Anurea,	0	0	2	0	0	0	1	0	0	pr.
Crustacea. Cyclops,	0	0	0	0	0	0	0	0	0	pr.
TOTAL ORGANISMS,	179	213	376	82	1,766	337	164	62	206	806

Table showing Heights of Water in Dug Pond at Times when Samples of Water were collected for Analysis.

NOTE. — High-water mark is 13.0 feet.

DATE.	Height of Water.	DATE.	Height of Water.
1889.		1890 — Con.	
June 4,	13.2	Mar. 3,	13.6
July 1,	12.5	April 1,	13.8
Aug. 5,	13.7	May 1,	13.2
Sept. 3,	13.0	June 2,	13.3
Oct. 2,	13.0	July 1,	12.2
Nov. 4,	13.2	Aug. 4,	10.8
Dec. 2,	14.1	Sept. 2,	9.9
1890.		Oct. 1,	9.8
Jan. 2,	13.4	Nov. 3,	13.2
Feb. 3,	13.2	Dec. 1,	13.0

WATER SUPPLY OF NEEDHAM.

Description of Works. — Population in 1890, 3,035. The works are owned by the town. Water was introduced near the end of 1890. The source of supply is a large well located in the valley of Colburn's Brook, in the south-eastern part of the town of Needham, a little less than a mile from the village, and about 2,000 feet from Charles River, into which the brook flows. The well is 22 feet in diameter and 24 feet in depth, with walls built of rubble stone laid dry and lined with a brick masonry 12 inches in thickness. The well is covered by a roof to exclude the light. Water is pumped from the well to the town, and to an iron tank located between the villages of Needham and Highlandville. The tank is 25 feet in diameter and 85 feet in height, and is covered by a roof, to exclude the light. Distributing mains are of cast iron; service pipes are generally of wrought iron lined with cement, but about one-eighth of them are of lead.

No analyses of the water from these works have been made since the works were completed. An analysis of the water of a test well was published in the special report of the Board on Water Supply and Sewerage, Part I., page 237.

WATER SUPPLY OF NEW BEDFORD.

Chemical Examination of Water from the Conduit of the New Bedford Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4861	June 20	June 21	V. sl't.	Cons.	2.50	–	–	.0022	.0332	.0286	.0046	–	.0050	.0000	–
4967	July 23	July 24	V. sl't.	Slight.	1.50	–	–	.0012	.0374	.0244	.0130	–	.0090	.0001	–
5085	Aug. 20	Aug. 21	V. sl't.	V. sl't.	2.00	–	–	.0000	.0296	.0258	.0038	–	.0250	.0001	–
5192	Sept. 18	Sept. 19	V. sl't.	V. sl't.	2.00	–	–	.0018	.0296	.0262	.0034	–	.0100	.0001	–
5265	Oct. 16	Oct. 17	V. sl't.	V. sl't.	1.50	–	–	.0012	.0270	.0242	.0028	–	.0120	.0000	–
5370	Nov. 20	Nov. 21	V. sl't	V. sl't.	1.80	–	–	.0024	.0262	.0208	.0054	–	.0120	.0001	–
5467	Dec. 19	Dec. 20	V. sl't.	None.	1.50	–	–	.0032	.0236	.0202	.0034	–	.0060	.0001	–
	1890.														
5561	Jan. 22	Jan. 23	V. sl't.	V. sl't.	1.50	–	–	.0008	.0208	.0184	.0024	–	.0200	.0001	–
5723	Feb. 26	Feb. 27	V. sl't.	V. sl't.	1.10	–	–	.0004	.0178	.0162	.0016	–	.0180	.0001	–
5802	Mar. 20	Mar. 21	V. sl't.	V. sl't.	1.30	–	–	.0006	.0176	.0160	.0016	.53	.0200	.0001	–
5894	Apr. 16	Apr. 17	V. sl't.	V. sl't.	0.80	–	–	.0006	.0174	.0118	.0056	.43	.0100	.0000	–
6000	May 21	May 22	V. sl't.	Cons.	1.50	–	–	.0018	.0242	.0214	.0028	.41	.0150	.0000	–
6143	June 27	June 28	Slight.	Slight.	1.80	–	–	.0014	.0320	.0262	.0058	.33	.0050	.0001	1.1
6276	July 22	July 23	V. sl't.	V. sl't.	2.10	5.40	–	.0016	.0352	.0304	.0048	.39	.0030	.0002	1.3
6429	Aug. 20	Aug. 21	V. sl't.	Slight.	1.50	4.50	2.60	.0030	.0228	.0186	.0042	.44	.0095	.0001	1.3
6529	Sept. 18	Sept. 18	Slight.	Slight.	0.90	4.55	2.00	.0000	.0214	.0174	.0040	.44	.0150	.0000	0.9
6634	Oct. 22	Oct. 23	V. sl't.	V. sl't.	1.80	4.95	2.05	.0008	.0244	.0210	.0034	.47	.0110	.0001	1.1
6750	Nov. 24	Nov. 25	V. sl't.	V. sl't.	1.70	5.65	2.75	.0016	.0218	.0194	.0024	.50	.0120	.0002	1.4
6841	Dec. 22	Dec. 23	None.	V. sl't.	1.70	5.40	2.65	.0032	.0224	.0174	.0050	.53	.0120	.0002	1.3
Av.	....	....	....	....	1.61	5.01	2.41	.0015	.0255	.0213	.0042	.45	.0121	.0001	1.2

Odor, faintly vegetable. —— The samples were collected from the conduit, which conveys water from the storage to the receiving reservoir, where it enters the latter. The storage reservoir was kept practically full during 1889 and 1890, and the variations in the height of the water were very slight.

NEW BEDFORD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination, ...	21	24	22	19	18	21	23	25	28
Number of sample, ...	4861	4967	5085	5192	5265	5370	5467	5561	5723
PLANTS.									
Diatomaceæ, ...	0	0	0	0	0	0	0	4	4
Asterionella, ...	0	0	0	0	0	0	0	0	2
Synedra, ...	0	0	0	0	0	0	0	4	2
Cyanophyceæ, ...	0	0	pr.	0	0	0	0	0	0
Anabæna, ...	0	0	0	0	0	0	0	0	0
Clathrocystis, ...	0	0	pr.	0	0	0	0	0	0
Algæ. Chlorococcus, ...	0	0	0	0	0	0	0	0	0
Fungi. Crenothrix, ...	pr.	2	pr.	2	0	5	1	2	pr.
ANIMALS.									
Infusoria. Dinobryon, . . .	0	0	0	0	0	0	0	0	7
Porifera. Sponge spicules, .	0	1	0	2	0	0	0	0	0
TOTAL ORGANISMS, ...	0	3	0	4	0	5	1	6	11

	1890.									
	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	22	19	23	28	23	22	20	23	25	23
Number of sample, ...	5802	5894	6000	6143	6276	6429	6529	6634	6750	6841
PLANTS.										
Diatomaceæ, ...	4	9	12	1	6	2	1	0	3	0
Asterionella, ...	0	7	4	1	0	0	0	0	0	0
Synedra, ...	4	2	8	pr.	6	2	1	0	3	0
Cyanophyceæ, ...	0	0	0	0	0	2	111	pr.	0	0
Anabæna, ...	0	0	0	0	0	0	13	0	0	0
Clathrocystis, ...	0	0	0	0	0	2	98	pr.	0	0
Algæ. Chlorococcus, ...	0	pr.	2	19	12	22	84	0	0	0
Fungi. Crenothrix, ...	1	1	26	11	21	3	7	0	1	0
ANIMALS.										
Infusoria. Dinobryon, ...	25	0	0	0	0	0	0	0	0	15
Porifera. Sponge spicules, . .	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS, ...	30	10	40	31	39	29	203	0	4	15

WATER SUPPLY OF NEWTON.

Chemical Examination of Water from the Newton Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5325	Nov. 8	Nov. 9	V. sl't.	None.	0.00	–	–	.0000	.0072	.0036	.0036	–	.0090	.0000	–
5326	Nov. 8	Nov. 9	Dec'd.	H'vy.	0.20	–	–	.0120	.1190	.0070	.1120	–	.0150	.0001	–
	1890.														
5615	Feb .10	Feb. 11	Slight.	None.	0.00	–	–	.0000	.0054	.0020	.0034	.31	.0150	.0001	–

Odor, No. 5325, faintly vegetable and unpleasant; No. 5326, none; No. 5615, none. —— Sample No. 5325 was collected from a faucet at city hall; No. 5326 was collected from a hydrant on Central Avenue and evidently contained some deposits flushed from the pipes; No. 5615 was collected from the distributing reservoir.

Microscopical Examination.

No. 5325. Diatomaceæ, *Asterionella*, 1,248.

No. 5326. Not examined.

No. 5615. Diatomaceæ, *Asterionella*, 2,393; *Synedra*, 10; *Tabellaria*, 3. Algæ, *Chlorococcus*, 2. Infusoria, *Monas*, 2; *Peridinium*, 1. Total organisms, 2,411.

Chemical Examination of Water from the Filter-basin of the Newton Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5323	Nov. 8	Nov. 9	Slight.	Slight.	0.00	–	–	.0000	.0062	.0034	.0028	–	.0100	.0000	–
5324	Nov. 8	Nov. 9	Slight.	Cons.	0.00	–	–	.0000	.0106	.0058	.0048	–	.0090	.0001	–
	1890.														
5614	Feb. 10	Feb. 11	V. sl't.	V. sl't.	0.00	–	–	.0000	.0014	–	–	.32	.0250	.0001	–

Odor of Nos. 5323 and 5324, faintly vegetable and unpleasant; of No. 5614, none. —— The samples were collected from the open basin. Sample No. 5323 was collected from the south end, and No. 5324 from the north end.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.		1890.
	Nov.	Nov.	Feb.
Day of examination,	9	9	12
Number of sample,	5323	5324	5614
PLANTS.			
Diatomaceæ,	**1,652**	**3,032**	**10**
Asterionella,	1,548	3,016	1
Epithemia,	2	0	0
Melosira,	12	2	0
Meridion,	22	0	0
Navicula,	30	6	0
Pinnularia,	2	0	0
Synedra,	32	6	9
Tabellaria,	4	2	0
Algæ. Scenedesmus,	**20**	**0**	**0**
TOTAL ORGANISMS,	1,672	3,032	10

Chemical Examination of Water from the Wells of the Newton Water Works.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6623	Oct. 18	Oct. 21	None.	None.	0.05	–	.0000	.0056	.42	.0100	.0001	1.9
6624	Oct. 18	Oct. 21	None.	None.	0.00	–	.0002	.0036	.43	.0250	.0001	2.1

Odor, none.——Sample No. 6623 was collected from well No. 37. Sample No. 6624 was collected from well No. 36. These wells are 19 feet apart. Temperature of well No. 37, 57° F.; of well No. 36, 65°.

Microscopical Examination.

No. 6623. Diatomaceæ, *Asterionella*, 1; *Melosira*, 21; *Tabellaria*, 2. Total organisms, 24.
No. 6624. Diatomaceæ, *Tabellaria*, 1.

NEWTON.

Chemical Examination of Water from the Charles River, opposite the Filter-basin of the Newton Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites	
	1890.														
6302	July 28	July 29	V. sl't.	V. sl't.	0.35	3.80	1.20	.0010	.0262	.0218	.0044	.38	.0010	.0002	1.89
6622	Oct. 18	Oct. 21	V. sl't.	Slight.	1.30	–	–	.0048	.0306	.0284	.0022	.43	.0100	.0003	1.56

Odor, vegetable. —— The samples were collected from the river.

Microscopical Examination.

No. 6302. Diatomaceæ, *Epithemia*, 6; *Nitzchia*, pr.; *Synedra*, 3. Cyanophyceæ, *Oscillaria*, pr. Algæ, *Chlorococcus*, 5; *Cœlastrum*, 2; *Scenedesmus*, pr.; *Sphærozosma*, pr.; *Spirogyra*, pr. Fungi, *Crenothrix*, 7. Infusoria, *Peridinium*, 3. Total organisms, 26.

No. 6622. Diatomaceæ, *Navicula*, 1; *Tabellaria*, 5. Fungi, *Crenothrix*, 17. Total organisms, 23.

WATER SUPPLY OF NORTHBRIDGE. — WHITIN MACHINE WORKS.

Chemical Examination of Water from the Reservoir of the Northbridge Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5574	Jan. 31	Feb. 1	V. sl't.	V. sl't.	0.05	2.95	0.90	.0000	.0042	.0030	.0012	–	.0090	.0001	–

Odor, none. —— The sample was collected from the reservoir. This reservoir supplies the village of Whitinsville, in Northbridge.

Microscopical Examination.

Diatomaceæ, *Tabellaria*, pr. Algæ, *Chlorococcus*, 7. Total organisms, 7.

WATER SUPPLY OF NORWOOD.

Chemical Examination of Water from Buckmaster Pond, in Dedham.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4831	June 13	June 14	Slight.	Dist't.	0.10	–	–	.0002	.0216	.0166	.0050	–	.0080	.0000	–
4930	July 10	July 11	Slight.	Slight.	0.10	–	–	.0008	.0260	.0212	.0048	–	.0030	.0001	–
5065	Aug. 15	Aug. 16	Dist't.	Slight.	0.05	–	–	.0006	.0224	.0190	.0034	–	.0060	.0000	–
5176	Sept. 12	Sept. 14	Slight.	Cons.	0.00	–	–	.0032	.0200	.0182	.0018	–	.0040	.0000	–
5252	Oct. 14	Oct. 16	V. sl't.	V. sl't.	0.05	–	–	.0026	.0204	.0188	.0016	–	.0020	.0000	–
5354	Nov. 18	Nov. 19	V. sl't.	V. sl't.	0.15	–	–	.0036	.0198	.0176	.0022	–	.0060	.0000	–
5436	Dec. 12	Dec. 13	V. sl't.	Slight.	0.10	–	–	.0034	.0162	.0150	.0012	–	.0040	.0001	–
	1890.														
5521	Jan. 12	Jan. 14	V. sl't.	V. sl't.	0.05	–	–	.0008	.0164	.0128	.0036	–	.0080	.0001	–
5672	Feb. 13	Feb. 14	V. sl't.	V. sl't.	0.05	–	–	.0002	.0146	.0128	.0018	–	.0050	.0000	–
5776	Mar. 11	Mar. 12	V. sl't.	V. sl't.	0.10	–	–	.0000	.0148	.0132	.0016	.33	.0080	.0001	–
5866	Apr. 9	Apr. 11	V. sl't.	Slight.	0.05	–	–	.0016	.0168	.0130	.0038	.28	.0070	.0000	–
5975	May 15	May 15	V. sl't.	V. sl't.	0.10	–	–	.0010	.0134	.0128	.0006	.28	.0030	.0000	–
6083	June 17	June 18	V. sl't.	V. sl't.	0.03	–	–	.0018	.0152	.0124	.0028	.27	.0050	.0000	–
6225	July 14	July 15	Slight.	Slight.	0.03	3.25	–	.0012	.0188	.0170	.0018	.28	.0000	.0001	1.3
6413	Aug. 14	Aug. 16	Slight.	Slight.	0.00	2.55	1.20	.0022	.0218	.0182	.0036	.33	.0085	.0000	1.1
6512	Sept. 13	Sept. 16	Slight.	Slight.	0.02	2.25	1.05	.0004	.0222	.0146	.0076	.26	.0020	.0000	0.8
6612	Oct. 15	Oct. 17	Slight.	Slight.	0.10	2.40	0.95	.0020	.0224	.0152	.0072	.32	.0080	.0000	0.8
6745	Nov. 20	Nov. 21	V. sl't.	Slight.	0.05	2.70	0.80	.0024	.0202	.0152	.0050	.31	.0100	.0000	0.9
6838	Dec. 18	Dec. 19	V. sl't.	V. sl't.	0.05	3.05	0.95	.0046	.0188	.0186	.0002	.35	.0250	.0000	1.1
Av.	....	....	....	....	0.06	2.59	0.99	.0017	.0190	.0159	.0031	.30	.0064	.0000	1.0

Odor, generally vegetable, rarely disagreeable, occasionally none. —— The samples were collected from the pond.

NORWOOD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	14	11	16	16	16	19	14	15	15	14
Number of sample,	4831	4930	5065	5176	5252	5354	5436	5521	5672	5776
PLANTS.										
Diatomaceæ,	pr.	pr.	pr.	pr.	28	17	5	3	11	0
Asterionella,	0	0	0	0	0	15	3	0	8	0
Melosira,	pr.	0	0	0	28	0	0	0	0	0
Stephanodiscus,	0	0	pr.	0	0	0	0	0	0	0
Synedra,	pr.	pr.	pr.	pr.	pr.	2	2	3	3	0
Cyanophyceæ,	0	0	0	0	0	0	0	pr.	0	0
Anabæna,	0	0	0	0	0	0	0	pr.	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Microcystis,	0	0	0	0	0	0	0	0	0	0
Nostoc,	0	0	0	0	0	0	0	0	0	0
Algæ,	0	4	2	7	23	45	4	2	4	0
Chlorococcus,	0	4	2	7	5	5	pr.	0	4	0
Desmidium,	0	0	0	0	0	12	0	0	0	0
Glœocapsa,	0	0	0	0	0	0	0	0	0	0
Merismopedia,	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	5	28	4	0	0	0
Sphærozosma,	0	0	0	0	0	0	0	2	0	0
Spirotænia,	0	0	0	0	13	0	0	0	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	0	0	0	0	0	0	0
Infusoria,	pr.	79	216	7	1	0	0	8	6	0
Dinobryon,	0	0	196	0	1	0	0	8	5	0
Peridinium,	pr.	79	20	7	0	0	0	0	1	0
Vorticella,	0	0	0	0	0	0	0	0	0	0
Crustacea. Cyclops,	pr.	pr.	0	0	pr.	0	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	0	83	218	14	52	62	9	13	21	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	12	16	18	16	19	16	17	22	19
Number of sample,	5866	5975	6083	6225	6413	6512	6612	6745	6838
PLANTS.									
Diatomaceæ,	**12**	**8**	**4**	**3**	**1**	**2**	**54**	**53**	**26**
Asterionella,	8	4	0	0	0	0	0	30	0
Melosira,	0	0	0	0	0	0	52	8	0
Stephanodiscus,	0	2	3	3	0	0	2	12	0
Synedra,	4	2	1	0	1	2	0	3	26
Cyanophyceæ,	**0**	**0**	**0**	**19**	**0**	**22**	**35**	**179**	**8**
Anabæna,	0	0	0	19	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	22	17	46	8
Microcystis,	0	0	0	0	0	0	18	104	0
Nostoc,	0	0	0	0	0	0	0	29	0
Algæ,	**pr.**	**47**	**27**	**13**	**12**	**35**	**50**	**31**	**15**
Chlorococcus,	pr.	4	27	13	12	0	0	6	0
Desmidium,	0	0	0	0	0	0	0	0	0
Glœocapsa,	0	0	0	0	0	35	0	0	0
Merismopedia,	0	0	0	0	0	0	28	0	0
Raphidium,	0	43	0	0	0	0	22	25	0
Sphærozosma,	0	0	0	0	0	0	0	0	15
Spirotænia,	0	0	0	0	0	0	0	0	0
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**	**0**
Infusoria,	**2**	**0**	**0**	**33**	**9**	**12**	**0**	**6**	**148**
Dinobryon,	0	0	0	pr.	0	0	0	6	148
Peridinium,	2	0	0	7	9	12	0	0	0
Vorticella,	0	0	0	26	0	0	0	0	0
Crustacea. Cyclops,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	14	55	31	68	22	71	140	274	197

PEABODY.

WATER SUPPLY OF PEABODY.

Chemical Examination of Water from Spring Pond, in Peabody.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.	1890.													
6827	Dec. 15	Dec. 16	V. sl't.	V. sl't.	0.0	4.15	1.35	.0006	.0174	.0166	.0008	.67	.0150	.0000	1.3

Odor, very faintly vegetable.—— The sample was collected from the pond.

Microscopical Examination.

Diatomaceæ, *Melosira*, 2; *Stephanodiscus*, 2; *Synedra*, 3; *Tabellaria*, 292. Algæ, *Raphidium*, 2. Infusoria, *Dinobryon*, 4; *Peridinium*, 1. Total organisms, 306.

PITTSFIELD.

Chemical Examination of Water from Pontoosuc Lake, Pittsfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.	1890.													
5630	Feb. 11	Feb. 12	V. sl't.	Slight.	0.0	9.05	0.60	.0000	.0062	.0048	.0014	.07	.0250	.0002	–

Odor, none.—— The sample was collected from the lake.

Microscopical Examination.

Diatomaceæ. *Asterionella*, 144; *Synedra*, 6. Infusoria, *Dinobryon*, 6; *Monas*, 10. Total organisms, 166.

Chemical Examination of Water from Onota Lake, Pittsfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	18	90.													
5717	Feb. 25	Feb. 26	Slight.	Cons.	0.00	7.30	1.35	.0024	.0118	.0096	.0022	.10	.0070	.0001	6.7

Odor, none. —— The sample was collected from the lake.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 14; *Fragillaria*, pr.; *Navicula*, pr.; *Stephanodiscus*, 2; *Synedra*, 31. Fungi, *Crenothrix*, pr. Infusoria, *Dinobryon*, 40; *Peridinium*, pr. Total organisms, 87.

PLYMOUTH.

Chemical Examination of Water from Pilgrim Spring, Plymouth.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
5915	Apr. 29	Apr. 30	None.	None.	0.0	8.20	.0000	.0008	1.43	.2500	.0001	3.1
6361	Aug. 5	Aug. 6	None.	None.	0.0	8.60	.0000	.0010	1.26	.2250	.0000	2.3

Odor, none. —— The samples were collected from the spring.

Microscopical Examination.

No. 6361. No organisms.

Chemical Examination of Water from a Tubular Well in Plymouth.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
6329	Aug. 1	Aug. 2	None.	Very slight.	0.00	3.60	.0000	.0014	.56	.0060	.0000	1.5

Odor, none. —— The sample was collected from a tubular well at Morton Park, about 100 feet from Little Pond.

Microscopical Examination.

No organisms.

WATER SUPPLY OF QUINCY. — QUINCY WATER COMPANY.

Chemical Examination of Water from Town Brook just above the Storage Reservoir of the Quincy Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4823	June 12	June 13	Slight.	Cons.	2.80	5.75	2.55	.0038	.0406	.0376	.0030	.46	.0060	.0002	–
4939	July 15	July 16	Slight.	Cons.	1.40	–	–	.0034	.0250	.0210	.0040	.47	.0100	.0003	–
5070	Aug. 16	Aug. 17	V. sl't.	Slight.	1.50	–	–	.0000	.0312	.0298	.0014	–	.0030	.0000	–
5181	Sept. 16	Sept. 17	V. sl't.	Cons.	2.00	–	–	.0026	.0362	.0308	.0054	–	.0040	.0001	–
5261	Oct. 16	Oct. 16	V. sl't.	V. sl't.	0.70	–	–	.0002	.0174	.0146	.0028	–	.0020	.0000	–
5373	Nov. 20	Nov. 21	V. sl't.	Cons.	0.50	–	–	.0002	.0170	.0138	.0032	–	.0100	.0001	–
5450	Dec. 17	Dec. 18	V. sl't.	V. sl't.	0.20	–	–	.0018	.0118	.0096	.0022	–	.0150	.0000	–
	1890.														
5556	Jan. 21	Jan. 22	V. sl't.	Slight.	0.40	–	–	.0016	.0110	.0098	.0012	–	.0150	.0000	–
5704	Feb. 24	Feb. 25	V. sl't.	Slight.	0.15	–	–	.0014	.0090	.0056	.0034	–	.0150	.0002	–
5797	Mar. 18	Mar. 19	V. sl't.	Slight, earthy.	0.45	–	–	.0000	.0092	.0064	.0028	.46	.0180	.0000	–
5895	Apr. 16	Apr. 17	V. sl't.	V. sl't.	0.35	–	–	.0004	.0136	.0120	.0016	.47	.0080	.0002	–
5996	May 20	May 21	Slight.	Cons.	1.10	–	–	.0008	.0260	.0218	.0042	.47	.0060	.0001	–
6120	June 24	June 25	Slight.	Cons.	0.80	–	–	.0046	.0194	.0154	.0040	.43	.0075	.0001	–
6270	July 21	July 22	V. sl't.	Slight.	0.80	4.85	–	.0028	.0172	.0148	.0024	.52	.0085	.0003	–
6420	Aug. 19	Aug. 20	Slight.	Cons.	0.65	5.50	2.30	.0138	.0428	.0326	.0102	.54	.0150	.0002	1.7
6515	Sept. 16	Sept. 17	Slight.	Cons.	2.30	7.25	3.70	.0012	.0376	.0340	.0036	.45	.0120	.0002	1.7
6629	Oct. 21	Oct. 21	V. sl't.	Slight.	1.20	5.25	2.10	.0006	.0190	.0158	.0032	.69	.0080	.0003	1.3
6755	Nov. 24	Nov. 25	None.	Slight.	0.40	4.30	1.25	.0010	.0102	.0086	.0016	.55	.0150	.0001	1.3
6844	Dec. 22	Dec. 23	V. sl't.	Slight.	0.15	3.80	1.50	.0010	.0094	.0086	.0008	.59	.0220	.0002	1.3
Av.	....	....	....	....	0.94	5.31	2.23	.0022	.0212	.0180	.0032	.51	.0105	.0001	1.3

Odor, faintly vegetable, increased on heating. —— The samples were collected from the brook above the storage reservoir.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	13	16	16	17	17	23	18	23	25	21
Number of sample,	4823	4939	5070	5181	5261	5373	5450	5556	5704	5797
PLANTS.										
Diatomaceæ,	3	0	0	pr.	pr.	9	9	19	15	5
Ceratoneis,	0	0	0	0	0	1	0	4	1	3
Meridion,	0	0	0	0	pr.	pr.	pr.	2	5	1
Navicula,	pr.	0	0	0	0	pr.	2	0	1	0
Synedra,	2	0	0	pr.	0	4	5	9	4	1
Tabellaria,	1	0	0	pr.	0	4	2	4	4	1
Cyanophyceæ. Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Algæ. Staurastrum,	0	0	0	0	0	0	0	0	0	0
Fungi. Crenothrix,	20	17	pr.	46	0	pr.	0	0	0	0
ANIMALS.										
Infusoria,	0	1	2	0	2	0	0	0	0	0
Ciliated infusorian,	0	1	2	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	2	0	0	0	0	0
Synura,	0	0	0	0	pr.	0	0	0	0	0
Porifera. Sponge spicules,	pr.	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	23	18	2	46	2	9	9	19	15	5

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	21	27	22	20	17	22	26	23
Number of sample,	5895	5996	6120	6270	6420	6515	6629	6755	6844
PLANTS.									
Diatomaceæ,	7	14	6	3	0	9	0	45	20
Ceratoneis,	pr.	4	4	0	0	0	0	0	0
Meridion,	1	0	0	0	0	6	0	31	15
Navicula,	0	0	0	2	0	2	0	3	3
Synedra,	6	8	2	1	0	1	0	7	pr.
Tabellaria,	0	2	0	0	0	0	0	4	2
Cyanophyceæ. Chroöcoccus,	0	0	0	0	31	0	0	0	0
Algæ. Staurastrum,	pr.	2	0	0	13	0	0	0	0
Fungi. Crenothrix,	pr.	2	0	4	11	26	20	pr.	0
ANIMALS.									
Infusoria,	34	0	0	6	2	0	0	4	pr.
Ciliated infusorian,	0	0	0	0	0	0	0	0	0
Monas,	0	0	0	3	0	0	0	0	pr.
Peridinium,	0	0	0	0	2	0	0	4	0
Synura,	34	0	0	3	0	0	0	0	0
Porifera. Sponge spicules,	0	2	0	0	0	0	0	0	0
TOTAL ORGANISMS,	41	20	6	13	57	35	20	49	20

QUINCY.

Chemical Examination of Water from the Storage Reservoir of the Quincy Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4824	June 12	June 13	V. sl't.	Slight.	1.20	4.70	2.00	.0226	.0382	.0344	.0038	.48	.0050	.0002	–
4940	July 15	July 16	Dist't.	Cons.	1.80	–	–	.0042	.0560	.0402	.0158	.53	.0020	.0002	–
5071	Aug. 16	Aug. 17	Slight.	Slight.	1.40	–	–	.0200	.0466	.0386	.0080	–	.0020	.0001	–
5182	Sept. 16	Sept. 17	V. sl't.	Slight.	1.80	–	–	.0352	.0356	.0336	.0020	–	.0050	.0004	–
5262	Oct. 16	Oct. 16	V. sl't.	Slight.	1.50	–	–	.0144	.0330	.0282	.0048	–	.0150	.0005	–
5374	Nov. 20	Nov. 21	V. sl't.	V. sl't.	1.00	–	–	.0068	.0238	.0184	.0054	–	.0230	.0002	–
5451	Dec. 17	Dec. 18	Dist't.	Slight.	0.30	–	–	.0238	.0152	.0132	.0020	–	.0150	.0001	–
	1890.														
5557	Jan. 21	Jan. 22	Dist't.	Cons.	0.40	–	–	.0210	.0166	.0122	.0044	–	.0250	.0001	–
5705	Feb. 24	Feb. 25	Dist't.	Slight.	0.20	–	–	.0140	.0162	.0100	.0062	–	.0150	.0002	–
5798	Mar. 18	Mar. 19	Slight.	Cons.	0.35	–	–	.0048	.0136	.0090	.0046	.51	.0210	.0001	–
5896	Apr. 16	Apr. 17	Dist't.	Slight.	0.25	–	–	.0016	.0168	.0104	.0064	.49	.0150	.0002	–
5995	May 20	May 21	Slight.	Cons.	0.40	–	–	.0016	.0252	.0168	.0084	.48	.0070	.0001	–
6119	June 24	June 25	Dist't.	Slight.	0.60	–	–	.0028	.0302	.0226	.0076	.51	.0125	.0001	–
6271	July 21	July 22	Slight.	Cons.	0.80	4.30	–	.0022	.0440	.0274	.0166	.56	.0000	.0004	–
6419	Aug. 19	Aug. 20	Slight.	Cons.	0.95	4.40	2.05	.0110	.0360	.0272	.0088	.54	.0040	.0001	1.6
6516	Sept. 16	Sept. 17	V. sl't.	Slight.	1.10	4.95	1.80	.0170	.0312	.0260	.0052	.50	.0150	.0002	1.4
6628	Oct. 21	Oct. 21	V. sl't.	Slight.	1.50	4.85	2.10	.0144	.0278	.0258	.0020	.56	.0250	.0003	1.4
6756	Nov. 24	Nov. 25	V. sl't.	Slight.	0.90	4.10	1.45	.0054	.0206	.0164	.0042	.57	.0250	.0002	1.3
6845	Dec. 22	Dec. 23	Slight.	Slight.	0.90	4.50	1.40	.0064	.0200	.0096	.0104	.63	.0350	.0002	1.3
Av.	....	....	....	....	0.91	4.58	1.80	.0121	.0288	.0221	.0067	.53	.0140	.0002	1.3

Odor, generally faintly vegetable. —— The samples were collected from the reservoir, near the surface at the dam.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	13	16	16	17	18	23	18	23	25	21
Number of sample,	4824	4940	5071	5182	5262	5374	5451	5557	5705	5798
PLANTS.										
Diatomaceæ,	**0**	**1**	**0**	**pr.**	**1**	**pr.**	**4**	**4**	**31**	**166**
Asterionella,	0	0	0	0	0	0	0	0	0	4
Synedra,	0	0	0	pr.	1	pr.	4	4	25	161
Tabellaria,	0	1	0	0	0	0	0	pr.	6	1
Algæ,	**0**	**941**	**3**	**40**	**0**	**0**	**0**	**pr.**	**21**	**48**
Chlorococcus,	0	940	2	38	0	0	0	0	pr.	1
Closterium,	0	1	1	0	0	0	0	pr.	21	47
Cosmarium,	0	0	0	0	0	0	0	0	0	pr.
Staurastrum,	0	0	0	2	0	0	0	0	0	0
Staurogenia,	0	0	0	0	0	0	0	0	0	0
Fungi. Crenothrix,	**2**	**3**	**0**	**pr.**	**pr.**	**6**	**pr.**	**pr.**	**0**	**0**
ANIMALS.										
Infusoria,	**0**	**1**	**2**	**140**	**0**	**0**	**0**	**4**	**24**	**101**
Dinobryon,	0	0	2	140	0	0	0	0	14	12
Monas,	0	0	0	0	0	0	0	0	pr.	69
Peridinium,	0	0	0	0	0	0	0	4	10	20
Synura,	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	1	0	0	0	0	0	pr.	0	0
Vermes,	**0**	**0**	**pr.**	**0**	**0**	**pr.**	**pr.**	**0**	**pr.**	**pr.**
Anuræa,	0	0	0	0	0	0	0	0	0	0
Polyarthra,	0	0	pr.	0	0	0	pr.	0	pr.	pr.
Rotatorian ova,	0	0	0	0	0	pr.	0	0	0	0
Crustacea. Cyclops,	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	2	946	5	180	1	6	4	8	76	315

QUINCY.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	21	27	22	20	17	22	26	23
Number of sample,	5896	5995	6119	6271	6419	6516	6628	6756	6845
PLANTS.									
Diatomaceæ,	**753**	**2,726**	**146**	**936**	**742**	**195**	**211**	**474**	**177**
Asterionella,	0	2,720	134	656	742	195	211	455	177
Synedra,	750	4	8	280	pr.	0	0	9	0
Tabellaria,	3	2	4	0	0	0	0	10	0
Algæ,	**1**	**52**	**494**	**682**	**90**	**85**	**0**	**0**	**0**
Chlorococcus,	0	38	14	6	87	85	0	0	0
Closterium,	1	0	0	0	pr.	0	0	0	0
Cosmarium,	0	0	4	92	0	0	0	0	0
Staurastrum,	0	14	0	584	1	0	0	0	0
Staurogenia,	0	0	476	0	2	0	0	0	0
Fungi. Crenothrix,	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**1**	**0**
ANIMALS.									
Infusoria,	**57**	**1,458**	**14**	**6**	**9**	**0**	**0**	**2**	**26**
Dinobryon,	4	1,246	14	0	6	0	0	0	pr.
Monas,	45	0	0	0	0	0	0	0	0
Peridinium,	7	2	0	0	0	0	0	2	2
Synura,	1	210	0	0	0	0	0	0	24
Trachelomonas,	0	0	0	6	3	0	0	0	0
Vermes,	**0**	**2**	**2**	**2**	**1**	**3**	**0**	**0**	**0**
Anurea,	0	0	0	0	1	3	0	0	0
Polyarthra,	0	0	2	0	0	0	0	0	0
Rotatorian ova,	0	2	0	2	0	0	0	0	0
Crustacea. Cyclops,	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**2**	**pr.**	**0**
TOTAL ORGANISMS,	812	4,239	656	1,626	842	283	216	477	203

WATER SUPPLY OF RANDOLPH AND HOLBROOK.

Chemical Examination of Water from the Brook flowing from Great Pond in Randolph and Braintree.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6835	Dec. 16	Dec. 18	V. sl't.	Slight.	0.40	4.05	1.25	.0018	.0202	.0196	.0006	.53	.0220	.0000	1.1

Odor, distinctly vegetable. —— The sample was collected from the brook a short distance below the pond.

Microscopical Examination.

Diatomaceæ, *Meridion*, 4; *Navicula*, 2; *Nitzchia*, pr.; *Pinnularia*, 2; *Synedra*, 8; *Tabellaria*, pr. Cyanophyceæ, *Anabæna*, 2. Algæ, *Staurastrum*, pr. Fungi, *Beggiatoa*, 1; *Crenothrix*, 6. Total organisms, 25.

PROPOSED WATER SUPPLY OF READING.

The following samples were taken from a tubular test well near the Ipswich River, just above Mill Street, in the northerly part of Reading. Works for supplying the town from this source are now nearly completed.

Chemical Examination of Water from a Tubular Well in Reading.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS		Hardness
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
5565	Jan. 24	Jan. 24	Decided.	Cons., e'thy.	0.00	–	.0008	.0030	.50	.0120	.0001	3.0
5801	Mar. 20	Mar. 21	Distinct.	Cons., e'thy.	0.00	8.10	.0000	.0018	.38	.0060	.0000	3.2

Odor, none. —— The samples were collected from a tubular test well, after pumping but a short time, which accounts for the turbidity and sediment.

Microscopical Examination.

No organisms.

REVERE.

WATER SUPPLY OF REVERE. — REVERE WATER COMPANY.

Chemical Examination of Water from the Wells of the Revere Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
5809	Mar. 24	Mar. 24	Slight.	None.	0.0	–	.0008	.0012	3.39	.1750	.0024	–

Odor, none.—— The sample was collected from a faucet in the boiler-room at the pumping-station.

Microscopical Examination.

Diatomaceæ, *Melosira*, 9.

Chemical Examination of Water from the Distributing Reservoir of the Revere Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
5810	Mar. 24	Mar. 24	Very slight.	Very slight.	0.0	–	.0010	.0042	3.26	.1200	.0018	–

Odor, none; unpleasant when heated.——The sample was collected from the reservoir at the surface.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 43; *Synedra*, *4,000. Total organisms, 4,043.

ROCKPORT.

Chemical Examination of Water from Cape Pond, Rockport.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
5803	Mar. 20	Mar. 21	V. sl't.	V. sl't.	0.50	10.00	2.40	.0288	.0334	.0206	.0128	4.26	.0090	.0001	–
5811	Mar. 24	Mar. 25	Slight.	Slight.	0.55	9.80	2.90	.0182	.0264	.0180	.0084	4.09	.0050	.0001	1.1
5812	Mar. 24	Mar. 25	Slight.	Slight.	0.50	9.90	3.30	.0184	.0242	.0172	.0070	4.21	.0070	.0001	1.1

Odor, vegetable and somewhat unpleasant.——No. 5803 was taken from the pond at the southeasterly end, near a swamp. No. 5811 was collected from near the middle of the pond, at the surface. No. 5812 was collected at the same place as No. 5811, but at a depth of 18 feet beneath the surface where the total depth was 20 feet.

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* Estimated.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	Mar.	Mar.	Mar.
Day of examination,	22	26	26
Number of sample,	5803	5811	5812
PLANTS.			
Diatomaceæ,	**970**	**2,196**	**1,631**
Asterionella,	782	1,764	1,248
Stephanodiscus,	0	0	3
Tabellaria,	188	432	380
Cyanophyceæ. Chroöcoccus,	**22**	**0**	**0**
Algæ,	**85**	**172**	**201**
Chlorococcus,	75	158	192
Cœlastrum,	1	7	0
Dictyosphærium,	pr.	1	4
Spirotænia,	4	5	3
Staurastrum,	0	1	2
Zoöspores,	5	0	0
ANIMALS.			
Infusoria,	**65**	**130**	**165**
Dinobryon,	62	124	154
Monas,	0	3	5
Peridinium,	1	3	6
Trachelomonas,	2	0	0
Vermes. Polyarthra,	**pr.**	**0**	**0**
Crustacea,	**0**	**pr.**	**pr.**
Cyclops,	0	pr.	pr.
Daphnia,	0	pr.	0
TOTAL ORGANISMS,	1,142	2,498	1,997

Chemical Examination of Water from a Brook in Rockport.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1890.														
5815	Mar. 24	Mar. 25	V. sl't.	Slight.	0.5	4.70	2.10	.0004	.0068	.0056	.0012	.97	.0400	.0001	1.3

Odor, faintly vegetable. —— The samples were collected from the brook which flows along the southeasterly side of the railroad near its terminus, in Rockport, at the point where the brook crosses Railroad Avenue.

Microscopical Examination.

Diatomaceæ, *Ceratoneis*, pr.; *Gonphonema*, pr.; *Meridion*, 2; *Navicula*, 1; *Synedra*, 7; *Tabellaria*, 2. Algæ, *Closterium*, pr. Fungi, *Crenothrix*, 2. Total organisms, 14.

SALEM.

WATER SUPPLY OF SALEM.

Chemical Examination of Water from Wenham Lake, Salem Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4799	June 6	June 7	V. sl't.	V. sl't.	0.05	–	–	.0008	.0170	.0134	.0036	.71	.0030	.0004	–
4929	July 9	July 11	Slight.	Slight.	0.05	–	–	.0036	.0228	.0190	.0038	.73	.0050	.0001	–
5048	Aug. 12	Aug. 13	Slight.	Slight.	0.03	–	–	.0016	.0250	.0186	.0064	–	.0030	.0001	–
5168	Sept. 10	Sept. 12	V. sl't.	Slight.	0.02	–	–	.0012	.0192	.0168	.0024	–	.0030	.0000	–
5232	Oct. 8	Oct. 9	V. sl't.	Slight.	0.05	–	–	.0014	.0170	.0126	.0044	–	.0020	.0001	–
5336	Nov. 12	Nov. 13	V. sl't.	V. sl't.	0.15	–	–	.0032	.0160	.0148	.0012	–	.0050	.0002	–
5422	Dec. 9	Dec. 10	V. sl't.	V. sl't.	0.10	–	–	.0028	.0164	.0132	.0032	–	.0120	.0002	–
	1890.														
5506	Jan. 7	Jan. 8	V. sl't.	V. sl't.	0.05	–	–	.0004	.0124	.0102	.0022	–	.0150	.0001	–
5613	Feb. 10	Feb. 11	Slight.	V. sl't.	0.10	–	–	.0000	.0136	.0092	.0044	–	.0120	.0000	–
5756	Mar. 10	Mar. 11	V. sl't.	V. sl't.	0.20	–	–	.0004	.0132	.0100	.0032	.85	.0150	.0002	–
5859	Apr. 8	Apr. 9	V. sl't.	V. sl't.	0.05	–	–	.0018	.0156	.0110	.0046	.75	.0120	.0001	–
5959	May 12	May 13	Slight.	Slight.	0.00	–	–	.0050	.0242	.0210	.0032	.72	.0030	.0001	–
6072	June 17	June 18	Slight.	Slight.	0.03	–	–	.0024	.0136	.0124	.0012	.69	.0030	.0000	–
6192	July 8	July 9	Slight.	V. sl't.	0.00	4.20	–	.0022	.0186	.0148	.0038	.68	.0015	.0000	2.3
6397	Aug. 13	Aug. 14	Slight.	Slight.	0.00	4.55	1.35	.0012	.0210	.0162	.0048	.74	.0030	.0000	2.6
6486	Sept. 9	Sept. 10	Slight.	Slight.	0.00	4.65	0.90	.0000	.0118	.0104	.0014	.72	.0100	.0001	2.6
6578	Oct. 8	Oct. 9	None.	V. sl't.	0.05	4.40	0.90	.0022	.0118	.0104	.0014	.66	.0120	.0000	2.7
6703	Nov. 10	Nov. 11	V. sl't.	V. sl't.	0.10	4.95	0.90	.0018	.0114	.0098	.0016	.81	.0180	.0001	2.6
6800	Dec. 9	Dec. 11	Slight.	V. sl't.	0.05	4.30	0.45	.0012	.0174	.0144	.0030	.75	.0200	.0000	2.2
Av.	....	....	....	....	0.06	4.57	0.90	.0017	.0167	.0136	.0031	.73	.0083	.0001	2.5

Odor, generally vegetable, frequently unpleasant, occasionally none. —— The samples were collected from a faucet in the pumping-station, while pumping, or from the lake about 40 feet from shore and one foot beneath the surface, in the vicinity of the intake pipe. For a series of samples from this lake at various depths, see special report on Water Supply and Sewerage, Part I., page 767.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	10	11	13	11	9	14	9	8	11
Number of sample,	4799	4929	5048	5168	5232	5336	5422	5506	5613
PLANTS.									
Diatomaceæ,	**8**	**7**	**pr.**	**19**	**139**	**266**	**168**	**413**	**1,489**
Asterionella,	0	2	pr.	1	24	35	25	266	1,223
Melosira,	0	0	0	2	69	220	119	84	95
Nitzchia,	0	0	0	0	0	0	0	0	0
Stephanodiscus,	8	5	0	0	4	10	17	15	49
Synedra,	0	0	0	16	42	1	pr.	27	63
Tabellaria,	0	0	0	0	0	0	7	21	59
Cyanophyceæ,	**pr.**	**26**	**23**	**31**	**38**	**4**	**3**	**5**	**2**
Anabæna,	0	1	3	7	1	0	0	0	0
Aphanocapsa,	0	0	0	3	0	0	0	0	0
Chroöcoccus,	0	8	0	6	0	0	0	0	0
Clathrocystis,	0	2	2	3	6	2	0	0	0
Cœlosphærium,	pr.	15	18	12	31	2	3	5	2
Algæ,	**pr.**	**8**	**4**	**0**	**36**	**17**	**6**	**10**	**15**
Chlorococcus,	pr.	8	0	0	36	12	6	9	15
Raphidium,	0	0	4	0	0	5	0	0	0
Scenedesmus,	pr.	0	0	0	0	0	pr.	1	pr.
ANIMALS.									
Infusoria,	**0**	**9**	**3**	**9**	**7**	**3**	**pr.**	**pr.**	**2**
Ceratium,	0	4	0	0	0	0	0	0	0
Dinobryon,	0	3	pr.	5	0	0	0	0	pr.
Monas,	0	0	0	0	0	0	0	0	0
Peridinium,	0	1	3	3	1	0	0	0	0
Trachelomonas,	0	1	0	1	6	3	pr.	pr.	2
Crustacea. Cyclops,	**0**	**pr.**	**0**	**0**	**pr.**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	8	50	30	59	220	290	177	428	1,508

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	12	9	13	18	10	14	10	9	11	10
Number of sample,	5756	5859	5959	6072	6192	6397	6486	6578	6703	6800
PLANTS.										
Diatomaceæ,	**1,171**	**234**	**251**	**159**	**42**	**208**	**4**	**5**	**525**	**1,054**
Asterionella,	950	61	43	0	0	0	0	0	116	348
Melosira,	52	75	30	3	8	10	0	0	340	378
Nitzchia,	0	0	0	0	0	0	0	3	17	92
Stephanodiscus,	21	30	106	117	5	4	0	0	13	30
Synedra,	88	29	6	0	10	194	4	2	38	204
Tabellaria,	60	39	66	39	19	0	0	0	1	2

SALEM.

Microscopical Examination.— Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.										
Cyanophyceæ,	**0**	**0**	**pr.**	**13**	**48**	**22**	**17**	**0**	**12**	**0**
Anabæna,	0	0	0	7	0	4	16	0	0	0
Aphanocapsa,	0	0	0	0	18	0	1	0	0	0
Chroöcoccus,	0	0	0	0	0	8	0	0	2	0
Clathrocystis,	0	0	0	3	7	6	0	0	0	0
Cœlosphærium,	0	0	pr.	3	23	4	0	0	10	0
Algæ,	**1**	**1**	**38**	**19**	**19**	**10**	**1**	**8**	**19**	**28**
Chlorococcus,	1	1	37	19	19	10	1	8	5	13
Raphidium,	0	0	0	0	0	0	0	0	9	8
Scenedesmus,	0	0	1	0	pr.	0	0	0	5	7
ANIMALS.										
Infusoria,	**14**	**43**	**44**	**0**	**12**	**12**	**4**	**0**	**10**	**13**
Ceratium,	0	0	0	0	0	0	0	0	0	0
Dinobryon,	9	43	43	0	10	0	0	0	6	12
Monas,	5	0	0	0	0	0	0	0	0	0
Peridinium,	0	pr.	1	0	2	12	3	0	0	0
Trachelomonas,	0	0	0	0	0	0	1	0	4	1
Crustacea. Cyclops,	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	1,186	278	333	191	121	252	26	13	566	1,095

Table showing Heights of Water in Wenham Lake at Times when Samples of Water were collected for Analysis.

[NOTE.— High-water mark is 30.17 feet.]

DATE.	Height of Water.	DATE.	Height of Water.
1889.		**1890.** — Con.	
June 6,	30.1	Mar. 10,	30.0
July 9,	29.6	April 8,	30.2
Aug. 12,	29.7	May 12,	30.2
Sept. 10,	29.3	June 17,	30.3
Oct. 8,	29.2	July 8,	29.8
Nov. 12,	29.1	Aug. 13,	28.7
Dec. 9,	29.9	Sept. 9,	28.1
1890.		Oct. 8,	27.7
Jan. 7,	29.8	Nov. 10,	28.4
Feb. 10,	29.8		

SANDISFIELD.

Chemical Examination of Water from a Spring in Sandisfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
5351	Nov. 14	Nov. 16	None.	Very slight.	0.20	3.00	.0006	.0058	.12	.0050	.0000	–

Odor, none. —— The sample was collected from a spring which supplies about 10 families in the village of New Boston.

Microscopical Examination.

Diatomaceæ, *Navicula*, pr.; *Synedra*, 2. Fungi, *Crenothrix*, 1. Total organisms, 3.

WATER SUPPLY OF THE REFORMATORY PRISON FOR WOMEN AT SHERBORN.

Chemical Examination of Water from Faucets at the Reformatory Prison for Women, Sherborn.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6355	Aug. 4	Aug. 5	V. sl't.	V. sl't.	0.05	4.15	1.20	.0002	.0156	.0128	.0028	.26	.0070	.0002	2.6
6356	Aug. 4	Aug. 5	None.	None.	0.10	4.35	1.45	.0000	.0124	.0118	.0006	.28	.0075	.0000	2.1
6357	Aug. 4	Aug. 5	Dec'd.	H'vy.	0.20	5.25	1.10	.0014	.0260	.0108	.0152	.52	.0050	.0000	2.7

Odor, distinct, peculiar. —— Sample No. 6355 was collected from a faucet in a house connected with the prison; No. 6356 from a faucet in the barn; No. 6357 from the dead-end of a pipe of the Framingham Water Company at the Prison. Nos. 6355 and 6356 probably represent water from Waushakum Pond.

SHERBORN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	Aug.	Aug.	Aug.
Day of examination,	6	6	6
Number of sample,	6355	6356	6357
PLANTS.			
Algæ. Chlorococcus,	0	3	0
Fungi. Crenothrix,	2	0	*1,600
TOTAL ORGANISMS,	2	3	1,600

* Estimated.

SOUTHBOROUGH.

Chemical Examination of Water from a Tubular Well in Southborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.	
	18	89.										
5424	Dec. 9	Dec. 10	Very slight.	Consider'ble.	0.0	4.50	.0000	.0016	.33	.1100	.0000	1.6

Odor, none. —— The sample was collected from a tubular test well near the Worcester turnpike, not far from Fayville. Water had been pumped from the well for about two hours previous to the time of collecting the sample.

Microscopical Examination.

No organisms.

Chemical Examination of Water from Stony Brook, in Southborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	18	89.													
5425	Dec. 9	Dec. 10	V. sl't.	V. sl't.	1.0	4.75	2.15	.0006	.0208	.0192	.0016	.25	.0080	.0002	1.4

Odor, vegetable and mouldy. —— The sample was collected from Stony Brook at the point where it crosses Folly road, the next road above the test well. The brook was high at the time the sample was collected.

Microscopical Examination.

Diatomaceæ, *Navicula*, pr.; *Synedra*, 1. Fungi, *Crenothrix*, 2. Total organisms, 3.

WATER SUPPLY OF SPRINGFIELD.

Chemical Examination of Water from the Gate-house of the Ludlow Reservoir, Springfield Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
4767	June 3	June 4	Dist't.	Cons.	0.10	–	–	.0082	.0550	.0224	.0326	.09	.0050	.0003	–
4810	June 10	June 11	Dist't.	Cons.	0.10	–	–	.0196	.0440	.0224	.0216	–	.0020	.0000	–
4845	June 17	June 18	Slight.	Cons.	0.15	–	–	.0260	.0532	.0314	.0218	–	.0020	.0002	–
4872	June 24	June 25	Slight.	Cons.	0.20	–	–	.0014	.0684	.0372	.0312	–	.0030	.0001	–
4917	July 8	July 9	Slight.	Cons.	0.20	–	–	.0264	.0520	.0354	.0166	–	.0070	.0001	–
4941	July 15	July 16	Dist't.	Cons.	0.20	–	–	.0008	.0806	.0314	.0492	–	.0020	.0002	–
4989	July 29	July 30	Dist't.	Cons.	0.15	–	–	.0000	.0736	.0274	.0462	–	.0020	.0001	–
5028	Aug. 5	Aug. 6	Dec'd.	Slight.	0.10	–	–	.0000	.0714	.0264	.0450	–	.0030	.0001	–
5051	Aug. 12	Aug. 13	Dist't.	Cons.	0.10	–	–	.0004	.0714	.0246	.0468	–	.0020	.0000	–
5077	Aug. 19	Aug. 20	Dec'd.	Slight.	0.15	–	–	.0006	.0684	.0238	.0446	–	.0060	.0001	–
5117	Aug. 30	Aug. 31	Dist't.	Cons.	0.10	–	–	.0012	.0906	.0298	.0608	–	.0040	.0001	–
5155	Sept. 9	Sept. 10	Dist't.	Slight.	0.05	–	–	.0004	.0772	.0256	.0516	–	.0020	.0001	–
5185	Sept. 16	Sept. 17	Dist't.	Cons.	0.15	–	–	.0070	.0416	.0280	.0136	–	.0020	.0000	–
5206	Sept. 30	Oct. 1	Dist't.	Cons.	0.15	–	–	.0000	.0508	.0284	.0224	–	.0020	.0001	–
5242	Oct. 9	Oct. 10	Slight.	Cons.	0.10	–	–	.0004	.0468	.0248	.0220	–	.0020	.0001	–
5279	Oct. 24	Oct. 25	Slight.	Cons.	0.35	–	–	.0002	.0624	.0278	.0346	–	.0020	.0001	–
5329	Nov. 11	Nov. 12	Dist't.	Cons.	0.20	–	–	.0002	.0496	.0302	.0194	–	.0030	.0001	–
5381	Nov. 25	Nov. 26	Slight.	Cons.	0.10	–	–	.0036	.0392	.0272	.0120	–	.0040	.0001	–
5447	Dec. 16	Dec. 18	Dist't.	Cons.	0.05	–	–	.0038	.0474	.0252	.0222	–	.0040	.0001	–
	18	90.													
5550	Jan. 20	Jan. 21	Slight.	Cons.	0.10	–	–	.0002	.0272	.0196	.0076	–	.0180	.0000	–
5660	Feb. 13	Feb. 14	Slight.	Slight.	0.15	–	–	.0000	.0224	.0160	.0064	–	.0020	.0000	–
5784	Mar. 12	Mar. 13	Slight.	Cons.	0.15	–	–	.0000	.0196	.0136	.0060	–	.0020	.0002	–
5819	Mar. 26	Mar. 27	Dist't.	Cons.	0.20	–	–	.0000	.0122	.0096	.0026	–	.0020	.0000	–
5874	Apr. 10	Apr. 11	Dist't.	Cons.	0.05	–	–	.0008	.0242	.0128	.0114	–	.0040	.0000	–
5908	Apr. 24	Apr. 26	Dist't.	Much.	0.05	–	–	.0006	.0274	.0146	.0128	.12	.0040	.0000	–
5960	May 12	May 13	Slight.	Cons.	0.03	–	–	.0002	.0224	.0142	.0082	.10	.0030	.0000	–
6009	May 28	May 29	Dist't.	Cons.	0.05	–	–	.0004	.0582	.0202	.0380	–	.0020	.0000	–
6114	June 23	June 24	Dist't.	Cons.	0.20	–	–	.0304	.0522	.0314	.0208	.09	.0070	.0003	0.8
6217	July 14	July 15	Dist't.	Cons.	0.50	3.90	–	.0014	.0754	.0392	.0362	.13	.0020	.0000	0.9
6421	Aug. 18	Aug. 20	Slight.	Cons.	0.05	3.55	2.20	.0002	.0560	.0228	.0332	.10	.0030	.0001	0.9
6517	Sept. 15	Sept. 17	Dec'd.	Cons.	0.10	–	–	.0000	.0468	.0180	.0288	–	.0030	.0001	–
6619	Oct. 20	Oct. 21	Slight.	Cons.	0.25	2.90	1.35	.0006	.0394	.0222	.0172	.09	.0070	.0003	1.3
6732	Nov. 17	Nov. 18	Slight.	Cons.	0.10	2.70	1.25	.0008	.0372	.0224	.0148	.13	.0070	.0001	0.9
6824	Dec. 15	Dec. 16	Slight.	Slight.	0.10	2.70	1.35	.0000	.0256	.0182	.0074	.08	.0200	.0001	0.9
Av.	....	....	....	....	0.15	2.96	1.54	.0035	.0456	.0235	.0221	.10	.0052	.0001	0.9

Odor, generally vegetable and grassy, increased on heating, occasionally disagreeable. —— The samples were collected in the gate-house, and represent water as it was being drawn from the reservoir for the supply of the city. At the time the samples were collected water was usually being drawn into the gate-house through an opening about seven feet below the surface. When the last sample was collected a small portion of the reservoir near the gate-house had been isolated from the main portion, and was receiving about 1,000,000 gallons of water per day directly from Higher Brook. The brook was turned into the basin on November 22, and at first discharged 1,500,000 gallons per day, decreasing gradually until the time of taking the sample.

SPRINGFIELD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.										
	June.	June.	June.	June.	July.	July.	July.	Aug.	Aug.	Aug.	Aug.
Day of examination,	–	11	18	25	9	16	30	6	13	20	31
Number of sample,	4767	4810	4845	4872	4917	4941	4989	5028	5051	5077	5117
PLANTS.											
Diatomaceæ,	–	**111**	**5**	**5**	**20**	**0**	**13**	**29**	**120**	**186**	**60**
Asterionella,	–	7	1	pr.	0	0	1	1	0	0	0
Melosira,	–	100	3	5	20	0	12	28	118	184	58
Navicula,	–	0	0	0	0	0	0	0	0	0	2
Stephanodiscus,	–	3	0	0	0	0	0	0	0	0	0
Synedra,	–	pr.	pr.	0	0	0	0	0	2	2	0
Tabellaria,	–	1	1	0	0	0	0	0	0	0	0
Cyanophyceæ,	–	**29**	**20**	**5**	**275**	**448**	**1,094**	**1,494**	**638**	**2,066**	**2,102**
Anabæna,	–	25	20	3	3	38	0	0	0	0	8
Aphanocapsa,	–	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	–	0	0	pr.	29	pr.	0	0	0	0	0
Clathrocystis,	–	4	pr.	2	2	4	12	18	6	2	6
Cœlosphærium,	–	0	0	0	241	406	1,082	1,476	632	2,064	2,088
Microcystis,	–	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores,	–	0	0	0	0	0	0	0	0	0	0
Algæ,	–	**9**	**1**	**10**	**141**	**63**	**53**	**153**	**8**	**8**	**24**
Chlorococcus,	–	5	0	1	88	0	20	146	0	0	10
Closterium,	–	0	0	0	0	0	0	0	0	0	0
Cœlastrum,	–	0	pr.	1	13	2	0	0	0	0	0
Dictyosphærium,	–	0	0	0	0	3	0	0	0	0	0
Pediastrum,	–	1	pr.	2	4	pr.	0	1	0	0	0
Raphidium,	–	0	0	pr.	0	0	0	0	0	0	0
Scenedesmus,	–	3	pr.	3	9	4	2	0	0	0	4
Sorastrum,	–	0	0	0	0	0	0	0	0	0	0
Staurastrum,	–	0	1	3	27	54	31	6	8	8	10
Zoöspores,	–	0	0	0	0	0	0	0	0	0	0
ANIMALS.											
Rhizopoda. Actinophrys,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	–	**0**	**0**	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**
Dinobryon,	–	0	0	0	0	0	0	0	0	0	0
Monas,	–	0	0	0	0	0	0	0	0	0	0
Peridinium,	–	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	–	0	0	pr.	pr.	pr.	0	0	0	0	0
Vermes,	–	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Anurea,	–	pr.	pr.	0	0	0	0	0	0	0	0
Polyarthra,	–	0	0	0	0	0	0	0	0	0	0
Rotifer,	–	0	0	0	0	0	0	0	0	0	0
Crustacea,	–	**pr.**	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**
Cyclops,	–	0	0	0	pr.	0	0	0	0	0	0
Daphnia,	–	pr.	pr.	pr.	0	0	0	0	0	0	0
TOTAL ORGANISMS,	–	149	26	20	436	511	1,160	1,676	766	2,260	2,186

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1889.								1890.		
	Sept.	Sept.	Oct.	Oct.	Oct.	Nov.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	17	2	12	26	12	27	18	22	15	15
Number of sample,	5155	5185	5206	5242	5279	5329	5381	5447	5550	5660	5784
PLANTS.											
Diatomaceæ,	**56**	**219**	**1,360**	**370**	**712**	**364**	**372**	**1,913**	**797**	**594**	**902**
Asterionella,	0	0	0	0	224	54	256	1,466	278	284	688
Melosira,	56	219	1,356	368	488	310	1,112	442	460	308	214
Navicula,	0	0	0	0	0	0	0	0	1	0	0
Stephanodiscus,	0	0	2	0	0	0	0	0	0	0	0
Synedra,	0	0	2	2	0	0	4	5	58	2	0
Tabellaria,	0	0	0	0	0	0	0	0	0	0	0
Cyanophyceæ,	**1,680**	**414**	**356**	**162**	**540**	**270**	**196**	**43**	**2**	**0**	**0**
Anabæna,	156	18	80	60	396	168	176	42	0	0	0
Aphanocapsa,	0	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	14	0	0	0	0	0
Clathrocystis,	4	2	44	20	20	4	4	0	0	0	0
Cœlosphærium,	1,520	394	196	52	100	84	16	1	2	0	0
Microcystis,	0	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores,	0	0	36	30	24	0	0	0	0	0	0
Algæ,	**72**	**36**	**282**	**1,928**	**840**	**146**	**360**	**67**	**38**	**10**	**28**
Chlorococcus,	60	17	54	1,868	738	52	286	23	24	6	22
Closterium,	0	0	0	6	0	8	8	6	0	1	6
Cœlastrum,	0	0	2	2	0	0	0	0	0	0	0
Dictyosphærium,	0	0	116	0	18	14	0	0	0	0	0
Pediastrum,	0	1	2	0	2	0	2	0	0	0	0
Raphidium,	0	13	90	36	58	58	24	0	0	0	0
Scenedesmus,	0	1	8	10	16	8	26	21	14	3	0
Sorastrum,	0	0	0	0	0	0	0	0	0	0	0
Staurastrum,	12	3	10	6	8	4	12	2	0	0	0
Zoöspores,	0	1	0	0	0	2	2	15	0	0	0
ANIMALS.											
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**0**	**4**	**16**	**6**	**4**	**8**	**26**	**11**	**73**	**3,284**	**302**
Dinobryon,	0	0	0	0	0	0	12	3	54	3,284	302
Monas,	0	0	0	0	0	0	2	0	0	0	0
Peridinium,	0	0	0	0	0	0	2	3	19	0	0
Trachelomonas,	0	4	16	6	4	8	10	5	0	0	0
Vermes,	**0**	**5**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**1**	**1**
Anurea,	0	5	0	0	0	0	0	0	0	0	0
Polyarthra,	0	0	0	0	0	0	2	2	0	1	1
Rotifer,	0	0	0	0	0	0	0	0	0	0	0
Crustacea,	**0**	**0**	**pr.**	**0**	**pr.**	**0**	**0**	**pr.**	**0**	**0**	**0**
Cyclops,	0	0	pr.	0	0	0	0	0	0	0	0
Daphnia,	0	0	pr.	0	pr.	0	0	pr.	0	0	0
TOTAL ORGANISMS,	1,808	678	2,014	2,466	2,096	790	956	2,036	910	3,889	1,233

SPRINGFIELD.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.											
	Mar.	April.	April.	May.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	28	12	26	13	31	25	15	20	17	21	19	17
Number of sample,	5819	5874	5908	5960	6009	6114	6217	6421	6517	6619	6732	6824
PLANTS.												
Diatomaceæ,	**1,510**	**4,268**	**5,756**	**3,302**	**950**	**138**	**300**	**684**	**1,481**	**719**	**1,037**	**182**
Asterionella,	1,136	2,252	2,584	2,288	360	23	0	16	16	464	264	30
Melosira,	364	2,004	3,164	1,004	575	105	300	668	1,462	248	768	152
Navicula,	0	0	0	6	10	5	0	0	3	0	2	0
Stephanodiscus,	0	12	0	0	0	0	0	0	0	0	2	0
Synedra,	2	0	8	4	5	5	0	0	0	4	0	0
Tabellaria,	8	0	0	0	0	0	0	0	0	3	1	0
Cyanophyceæ,	**30**	**0**	**50**	**80**	**1,650**	**471**	**204**	**872**	**1,450**	**268**	**220**	**8**
Anabæna,	0	0	0	60	1,600	445	108	0	152	15	1	0
Aphanocapsa,	0	0	0	0	0	0	0	0	10	17	4	1
Chroöcoccus,	30	0	34	0	0	0	0	0	69	53	181	4
Clathrocystis,	0	0	4	10	40	23	58	148	7	10	4	2
Cœlosphærium,	0	0	12	10	10	3	38	724	1,212	180	8	1
Microcystis,	0	0	0	0	0	0	0	0	0	3	22	0
Nostocaceous spores,	0	0	0	0	0	0	0	0	0	0	0	0
Algæ,	**44**	**6**	**46**	**306**	**20**	**15**	**195**	**170**	**81**	**68**	**140**	**43**
Chlorococcus,	38	0	40	282	0	0	3	0	34	50	19	6
Closterium,	0	0	0	0	0	0	0	0	0	0	0	0
Cœlastrum,	0	0	0	0	0	0	13	0	0	0	0	0
Dictyosphærium,	0	0	0	0	0	0	5	0	0	0	0	0
Pediastrum,	0	0	0	4	0	0	13	26	2	1	0	0
Raphidium,	0	0	0	0	0	0	35	40	15	7	29	1
Scenedesmus,	6	6	6	18	15	10	53	22	15	3	14	4
Sorastrum,	0	0	0	0	0	0	8	28	0	0	0	0
Staurastrum,	0	0	0	2	5	5	65	54	15	7	78	32
Zoöspores,	0	0	0	0	0	0	0	0	0	0	0	0
ANIMALS.												
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**28**	**0**
Infusoria,	**700**	**90**	**16**	**484**	**0**	**0**	**3**	**16**	**38**	**25**	**20**	**25**
Dinobryon,	696	78	14	478	0	0	0	0	0	10	12	20
Monas,	0	0	0	6	0	0	0	0	0	0	0	0
Peridinium,	2	12	0	0	0	0	3	0	0	1	3	3
Trachelomonas,	2	0	2	0	0	0	0	16	38	14	5	2
Vermes,	**6**	**4**	**0**	**2**	**0**	**3**	**0**	**0**	**1**	**1**	**3**	**2**
Anurea,	2	2	0	0	0	0	0	0	1	0	0	pr.
Polyarthra,	4	2	0	2	0	0	0	0	0	1	1	2
Rotifer,	0	0	0	0	0	3	0	0	0	0	2	0
Crustacea,	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**	**pr.**	**0**
Cyclops,	0	0	0	0	0	0	0	0	0	0	pr.	0
Daphnia,	0	0	0	0	0	0	pr.	0	0	0	0	0
TOTAL ORGANISMS,	2,290	4,368	5,868	4,174	2,620	627	702	1,742	3,051	1,084	1,448	260

SPRINGFIELD.

Chemical Examination of Water from Ludlow Reservoir at a depth of six feet beneath the surface.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4768	June 3	June 4	Dec'd.	Heavy.	0.10	–	–	.0006	.0698	.0248	.0450	.10	.0040	.0001	–
4811	June 10	June 11	Dec'd.	Cons.	0.10	–	–	.0022	.0602	.0242	.0360	–	.0020	.0000	–
4846	June 17	June 18	Dist't.	Cons.	0.20	–	–	.0128	.0746	.0402	.0344	–	.0020	.0003	–
4873	June 24	June 25	Slight.	Cons.	0.15	–	–	.0004	.0688	.0356	.0332	–	.0020	.0000	–
4918	July 8	July 9	Slight.	Heavy.	0.30	–	–	.0140	.0604	.0366	.0238	–	.0050	.0001	–
4942	July 15	July 16	Dist't.	Cons.	0.30	–	–	.0000	.0900	.0328	.0572	–	.0000	.0002	–
4965	July 22	July 23	Dist't.	Cons.	0.10	–	–	.0002	.0900	.0302	.0598	–	.0040	.0001	–
4990	July 29	July 30	Slight.	Cons.	0.15	–	–	.0000	.0754	.0288	.0466	–	.0020	.0001	–
5029	Aug. 5	Aug. 6	Dec'd.	Slight.	0.10	–	–	.0000	.0786	.0246	.0540	[illegible]	.0020	.0001	–
5052	Aug. 12	Aug. 13	Dist't.	Slight.	0.15	–	–	.0008	.0758	.0248	.0510	–	.0040	.0000	–
5078	Aug. 19	Aug. 20	Dec'd.	V. sl't.	0.15	–	–	.0012	.0670	.0224	.0446	–	.0040	.0001	–
5118	Aug. 30	Aug. 31	Dist't.	Cons.	0.10	–	–	.0002	.0634	.0270	.0364	–	.0050	.0001	–
5156	Sept. 9	Sept. 10	Slight.	Slight.	0.03	–	–	.0006	.0534	.0262	.0272	–	.0020	.0000	–
5186	Sept. 16	Sept. 17	Dist't.	Cons.	0.10	–	–	.0032	.0636	.0298	.0338	–	.0000	.0000	–
5207	Sept. 30	Oct. 1	Dist't.	Cons.	0.20	–	–	.0014	.0570	.0280	.0290	–	.0020	.0001	–
5243	Oct. 9	Oct. 10	Slight.	Cons.	0.10	–	–	.0002	.0554	.0276	.0278	–	.0050	.0000	–
5280	Oct. 24	Oct. 25	Slight.	Cons.	0.30	–	–	.0006	.0540	.0274	.0266	–	.0040	.0001	–
5330	Nov. 11	Nov. 12	Dist't.	Cons.	0.20	–	–	.0056	.0510	.0304	.0206	–	.0040	.0001	–
5382	Nov. 25	Nov. 26	Slight.	Cons.	0.10	–	–	.0044	.0522	.0318	.0204	–	.0040	.0001	–
5448	Dec. 16	Dec. 18	Slight.	Cons.	0.05	–	–	.0028	.0398	.0238	.0160	–	.0050	.0001	–
	1890.														
5551	Jan. 20	Jan. 21	Slight.	Cons.	0.10	–	–	.0016	.0282	.0186	.0096	–	.0060	.0001	–
5661	Feb. 13	Feb. 14	Dist't.	Slight.	0.10	–	–	.0000	.0204	.0162	.0042	–	.0030	.0001	–
5785	Mar. 12	Mar. 13	Slight.	Cons.	0.10	–	–	.0000	.0254	.0170	.0084	–	.0020	.0001	–
5820	Mar. 26	Mar. 27	Slight.	Cons.	0.20	–	–	.0000	.0188	.0094	.0094	–	.0030	.0002	–
5875	Apr. 10	Apr. 11	Dist't.	Cons.	0.05	–	–	.0002	.0240	.0126	.0114	–	.0020	.0000	–
5909	Apr. 24	Apr. 26	Dist't.	Cons.	0.05	–	–	.0000	.0248	.0138	.0110	.12	.0090	.0000	–
5961	May 12	May 13	Slight	Cons.	0.05	–	–	.0016	.0212	.0150	.0062	–	.0020	.0000	–
6010	May 28	May 29	Dist't.	Cons.	0.05	–	–	.0002	.0632	.0174	.0458	–	.0020	.0000	–
6115	June 23	June 24	Dist't.	Cons.	0.20	–	–	.0444	.0594	.0318	.0276	–	.0020	.0004	0.8
6218	July 14	July 15	Dist't.	Slight.	0.50	–	–	.0036	.0752	.0412	.0340	.11	.0020	.0000	0.8
6422	Aug. 18	Aug. 20	Slight.	Cons.	0.05	–	–	.0000	.0674	.0286	.0388	–	.0030	.0001	0.9
6518	Sept. 16	Sept. 17	Dist't.	Cons.	0.15	–	–	.0000	.0442	.0180	.0262	.11	.0050	.0001	1.2
6620	Oct. 20	Oct. 21	Slight.	Cons.	0.25	–	–	.0008	.0492	.0268	.0224	.09	.0070	.0003	1.2
6733	Nov. 17	Nov. 18	Slight.	Slight.	0.15	2.55	1.40	.0010	.0362	.0230	.0132	.12	.0070	.0001	0.8
6825	Dec. 15	Dec. 16	Slight.	Slight.	0.10	–	–	.0002	.0418	.0272	.0146	.09	.0200	.0001	0.9
Av.	....	....	....	....	0.15	–	–	.0037	.0491	.0248	.0243	.11	.0047	.0001	0.9

Odor, generally vegetable and grassy; increased by heating; occasionally disagreeable. —— The samples were collected from near the middle of the reservoir, at a depth of 6 feet beneath the surface, with the exception of No. 5448, which was collected at the filter-dam pier, 3 feet beneath the surface, and Nos. 5551, 5661 and 5785, which were collected at depths of 3 feet or less beneath the surface. During the period from June, 1889, to December, 1890, the reservoir was kept at from 2 to 11 feet below high water. For heights of water at the times when samples of water were collected, see page 245.

SPRINGFIELD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.											
	June.	June.	June.	June.	July.	July.	July.	July.	Aug.	Aug.	Aug.	Aug.
Day of examination,	–	11	18	25	11	16	23	30	6	13	20	31
Number of sample,	4768	4811	4846	4873	4918	4942	4965	4990	5029	5052	5078	5118
PLANTS.												
Diatomaceæ,	–	**30**	**2**	**2**	**3**	**0**	**19**	**16**	**50**	**34**	**192**	**46**
Asterionella,	–	0	0	0	0	0	0	1	2	0	0	0
Melosira,	–	30	2	2	3	0	19	15	48	34	190	46
Synedra,	–	pr.	pr.	0	0	0	0	0	0	0	2	0
Tabellaria,	–	pr.	0	0	0	0	0	0	0	0	0	0
Cyanophyceæ,	–	**122**	**23**	**9**	**337**	**362**	**805**	**1,300**	**654**	**634**	**1,588**	**560**
Anabæna,	–	120	23	5	12	24	17	0	0	0	2	0
Aphanocapsa,	–	0	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	–	0	0	0	0	0	0	0	0	0	0	0
Clathrocystis,	–	2	pr.	4	2	5	26	6	6	6	10	68
Cœlosphærium,	–	0	0	0	323	333	762	1,294	648	628	1,576	492
Microcystis,	–	0	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores,	–	0	0	0	0	0	0	0	0	0	0	0
Algæ,	–	**7**	**3**	**10**	**257**	**63**	**45**	**39**	**8**	**4**	**22**	**126**
Chlorococcus,	–	5	3	3	163	10	0	14	0	0	0	114
Closterium,	–	pr.	0	0	0	0	0	0	0	0	0	0
Cœlastrum,	–	0	0	2	15	2	0	0	0	2	0	0
Dictyosphærium,	–	0	0	0	0	0	0	0	0	0	0	0
Pediastrum,	–	0	pr.	pr.	3	2	0	0	0	0	0	0
Protococcus,	–	0	0	0	0	0	0	0	0	0	0	0
Raphidium,	–	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	–	2	pr.	4	5	2	2	0	0	0	6	0
Sorastrum,	–	0	0	0	0	0	0	0	0	0	0	0
Staurastrum,	–	pr.	pr.	1	71	47	43	25	8	2	16	12
ANIMALS.												
Rhizopoda. Actinophrys,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**0**
Dinobryon,	–	0	0	0	0	0	0	0	0	0	0	0
Monas,	–	0	0	0	0	0	0	0	0	0	0	0
Peridinium,	–	0	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	–	0	0	0	0	0	0	0	2	0	2	0
Vermes,	–	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**4**
Anurea,	–	pr.	pr.	0	0	0	0	0	0	0	0	2
Polyarthra,	–	0	0	pr.	0	0	0	0	2	0	0	0
Rotifer,	–	0	0	0	0	0	0	0	0	0	0	0
Rotatorian ova,	–	0	0	0	0	0	0	0	0	0	0	2
Crustacea,	–	**pr.**	**pr.**	**pr.**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**
Cyclops,	–	pr.	pr.	pr.	pr.	0	0	0	0	0	0	0
Daphnia,	–	pr.	pr.	pr.	0	pr.	0	0	0	0	0	0
TOTAL ORGANISMS,	–	159	28	21	597	425	869	1,355	716	672	1,804	736

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1889.								1890.		
	Sept.	Sept.	Oct.	Oct.	Oct.	Nov.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination, . .	10	17	2	12	26	12	27	18	22	15	15
Number of sample, . . .	5156	5186	5207	5243	5280	5330	5382	5448	5551	5661	5785
PLANTS.											
Diatomaceæ, ...	**92**	**193**	**1,196**	**372**	**228**	**612**	**1,390**	**940**	**660**	**465**	**557**
Asterionella, ...	0	9	8	18	106	94	432	598	166	276	428
Melosira, ...	90	184	1,188	354	122	516	952	340	344	49	119
Synedra, ...	2	0	0	0	0	2	6	2	150	140	4
Tabellaria, ...	0	0	0	0	0	0	0	0	0	0	6
Cyanophyceæ, ...	**1,028**	**920**	**242**	**160**	**392**	**374**	**96**	**7**	**0**	**1**	**60**
Anabæna, ...	30	56	60	0	260	272	88	7	0	0	0
Aphanocapsa, ...	0	0	0	0	0	0	0	0	0	0	4
Chroöcoccus, ...	0	0	0	0	0	10	0	0	0	0	56
Clathrocystis, ...	10	10	10	8	24	4	0	0	0	1	0
Cœlosphærium, ...	988	854	156	20	80	88	8	0	0	0	0
Microcystis, ...	0	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores, . .	0	0	16	60	28	0	0	0	0	0	0
Algæ, ...	**46**	**52**	**522**	**3,272**	**666**	**116**	**196**	**76**	**44**	**12**	**72**
Chlorococcus, ...	36	15	272	3,224	598	88	160	43	21	9	70
Closterium, ...	0	0	0	2	6	10	8	4	1	0	0
Cœlastrum, ...	0	1	0	2	2	0	0	0	0	0	0
Dictyosphærium, . . .	0	0	46	0	30	10	0	0	0	0	0
Pediastrum, ...	0	1	0	0	0	2	0	0	0	0	0
Protococcus, ...	0	0	0	0	0	0	0	0	0	0	0
Raphidium, ...	0	30	196	36	20	0	0	4	0	0	0
Scenedesmus, ...	6	1	2	4	4	6	26	24	8	3	2
Sorastrum, ...	0	0	0	0	2	0	0	0	0	0	0
Staurastrum, ...	4	4	6	4	4	0	2	1	14	0	0
ANIMALS.											
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria, ...	**4**	**6**	**4**	**2**	**2**	**2**	**18**	**17**	**35**	**3,644**	**2,891**
Dinobryon, ...	0	0	0	0	0	0	12	5	21	3,644	2,890
Monas, ...	0	0	0	0	0	0	0	2	0	0	0
Peridinium, ...	0	1	0	0	0	0	0	8	14	0	1
Trachelomonas, ...	4	5	4	2	2	2	6	2	0	0	0
Vermes, ...	**2**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**
Anurea, ...	0	1	0	0	0	0	0	0	1	0	0
Polyarthra, ...	2	0	0	0	0	0	0	0	0	1	0
Rotifer, ...	0	0	0	0	0	0	0	0	0	0	0
Rotatorian ova, ...	0	3	0	0	0	0	0	0	0	1	0
Crustacea, ...	**0**	**0**	**0**	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**
Cyclops, ...	0	0	0	0	pr.	pr.	0	0	0	0	0
Daphnia, ...	0	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS, .	1,172	1,175	1,964	3,806	1,288	1,104	1,700	1,040	740	4,124	3,580

SPRINGFIELD.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.											
	Mar.	April.	April.	May.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	28	12	26	13	31	25	15	21	17	22	19	18
Number of sample,	5820	5875	5909	5961	6010	6115	6218	6422	6518	6620	6733	6825
PLANTS.												
Diatomaceæ,	**1,268**	**4,056**	**4,704**	**1,824**	**410**	**143**	**68**	**1,940**	**1,304**	**1,022**	**542**	**240**
Asterionella,	940	2,016	2,280	1,492	150	0	0	0	24	356	190	110
Melosira,	328	2,040	2,424	332	225	143	68	1,940	1,280	668	350	96
Synedra,	0	0	0	16	0	0	0	0	0	0	2	34
Tabellaria,	0	0	0	0	35	0	0	0	0	0	0	0
Cyanophyceæ,	**8**	**8**	**36**	**52**	**1,120**	**506**	**710**	**54**	**644**	**97**	**220**	**19**
Anabæna,	0	0	8	38	1,110	490	200	0	56	5	4	0
Aphanocapsa,	0	0	0	0	0	0	0	0	0	26	24	pr.
Chroöcoccus,	8	0	16	0	0	0	0	28	26	44	158	13
Clathrocystis,	0	2	4	10	10	3	155	12	52	6	0	6
Cœlosphærium,	0	6	8	4	0	13	355	14	508	4	14	0
Microcystis,	0	0	0	0	0	0	0	0	2	12	20	0
Nostocaceous spores,	0	0	0	0	0	0	0	0	0	0	0	0
Algæ,	**58**	**36**	**20**	**196**	**50**	**13**	**241**	**184**	**20**	**115**	**141**	**46**
Chlorococcus,	50	34	8	168	35	8	38	44	2	87	86	0
Closterium,	0	0	0	2	0	0	0	0	0	0	0	0
Cœlastrum,	0	0	0	0	0	0	0	0	0	0	0	0
Dictyosphærium,	0	0	0	8	0	0	0	0	0	0	0	0
Pediastrum,	0	0	0	0	0	0	5	22	2	2	1	1
Protococcus,	0	0	0	0	0	0	0	0	0	0	0	18
Raphidium,	0	0	0	0	0	0	0	0	0	2	0	0
Scenedesmus,	8	0	12	12	10	5	95	28	6	13	6	5
Sorastrum,	0	0	0	4	0	0	13	44	4	0	0	0
Staurastrum,	0	2	0	2	5	0	90	46	6	11	48	22
ANIMALS.												
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**28**	**8**	**24**
Infusoria,	**934**	**192**	**34**	**322**	**5**	**0**	**0**	**68**	**12**	**4**	**68**	**171**
Dinobryon,	932	168	14	314	5	0	0	0	0	0	58	132
Monas,	0	0	0	8	0	0	0	0	0	0	0	0
Peridinium,	2	18	18	0	0	0	0	0	0	0	4	36
Trachelomonas,	0	6	2	0	0	0	0	68	12	4	6	3
Vermes,	**2**	**0**	**0**	**4**	**0**	**0**	**3**	**0**	**2**	**3**	**2**	**1**
Anurea,	2	0	0	0	0	0	0	0	0	1	0	0
Polyarthra,	0	0	0	2	0	0	0	0	0	2	2	1
Rotifer,	0	0	0	2	0	0	3	0	2	0	pr.	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0	0	0	pr.
Crustacea,	**0**	**0**	**0**	**pr.**	**0**	**0**	**0**	**pr.**	**0**	**pr.**	**pr.**	**0**
Cyclops,	0	0	0	pr.	0	0	0	pr.	0	pr.	pr.	0
Daphnia,	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	2,270	4,292	4,794	2,398	1,585	662	1,022	2,246	1,982	1,269	981	501

SPRINGFIELD.

Chemical Examination of Water from Ludlow Reservoir, collected at from two to four feet above the bottom.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4769	June 3	June 4	Dist't.	Cons.	0.10	–	–	.0108	.0426	.0242	.0184	.09	.0050	.0001	–
4812	June 10	June 11	Dist't.	Cons.	0.15	–	–	.0204	.0460	.0246	.0214	–	.0020	.0000	–
4847	June 17	June 18	Slight.	Cons.	0.20	–	–	.0378	.0434	.0294	.0140	–	.0020	.0003	–
4874	June 24	June 25	Dec'd.	Heavy.	0.20	–	–	.0660	.0486	.0282	.0204	–	.0020	.0001	–
4919	July 8	July 9	Slight.	Heavy.	0.30	–	–	.0480	.0484	.0364	.0120	–	.0030	.0001	–
4943	July 15	July 16	Dist't.	Slight.	0.20	–	–	.0000	.0812	.0336	.0476	–	.0020	.0002	–
4966	July 22	July 23	Dist't.	Cons.	0.10	–	–	.0232	.0762	.0316	.0446	–	.0050	.0002	–
4991	July 29	July 30	Dist't.	Slight.	0.15	–	–	.0000	.0652	.0292	.0360	–	.0020	.0001	–
5030	Aug. 5	Aug. 6	Dist't.	Cons.	0.10	–	–	.0008	.0564	.0232	.0332	–	.0020	.0002	–
5053	Aug. 12	Aug. 13	Dist't.	Slight.	0.40	–	–	.0000	.0730	.0264	.0466	–	.0020	.0001	–
5079	Aug. 19	Aug. 20	Dist't.	Slight.	0.20	–	–	.0008	.0546	.0242	.0304	–	.0030	.0001	–
5119	Aug. 30	Aug. 31	Dec'd.	Cons.	0.10	–	–	.0000	.0614	.0242	.0372	–	.0030	.0001	–
5157	Sept. 9	Sept. 10	Dec'd.	Heavy.	0.25	–	–	.0364	.0550	.0296	.0254	–	.0030	.0000	–
5187	Sept. 16	Sept. 17	Dist't.	Cons.	0.15	–	–	.0094	.0448	.0228	.0220	–	.0020	.0000	–
5208	Sept. 30	Oct. 1	Dist't.	Cons.	0.20	–	–	.0014	.0524	.0268	.0256	–	.0000	.0000	–
5244	Oct. 9	Oct. 10	Slight.	Cons.	0.10	–	–	.0002	.0532	.0254	.0278	–	.0030	.0000	–
5281	Oct. 24	Oct. 25	Slight.	Cons.	0.30	–	–	.0008	.0538	.0298	.0240	–	.0050	.0001	–
5331	Nov. 11	Nov. 12	Slight.	Cons.	0.20	–	–	.0050	.0512	.0312	.0200	–	.0020	.0001	–
5383	Nov. 25	Nov. 26	Slight.	Cons.	0.10	–	–	.0048	.0408	.0286	.0122	–	.0070	.0001	–
5449	Dec. 16	Dec. 18	Slight.	Cons.	0.05	–	–	.0038	.0402	.0242	.0160	–	.0040	.0001	–
	1890.														
5552	Jan. 20	Jan. 21	Slight.	Cons.	0.10	–	–	.0018	.0256	.0206	.0050	–	.0040	.0001	–
5662	Feb. 13	Feb. 14	Dist't.	Slight.	0.05	–	–	.0000	.0258	.0192	.0066	–	.0000	.0001	–
5786	Mar. 12	Mar. 13	Slight.	Cons.	0.10	–	–	.0004	.0226	.0134	.0092	–	.0020	.0002	–
5821	Mar. 26	Mar. 27	Slight.	Cons.	0.20	–	–	.0002	.0204	.0112	.0092	–	.0020	.0000	–
5876	Apr. 10	Apr. 11	Dec'd.	Cons.	0.05	–	–	.0000	.0204	.0106	.0098	–	.0030	.0000	–
5910	Apr. 24	Apr. 26	Dist't.	Cons.	0.05	–	–	.0000	.0222	.0126	.0096	.12	.0030	.0000	–
5962	May 12	May 13	Slight.	Heavy.	0.05	–	–	.0062	.0222	.0140	.0082	–	.0020	.0000	–
6011	May 28	May 29	Dist't.	Cons.	0.05	–	–	.0000	.0574	.0184	.0390	–	.0020	.0000	–
6116	June 23	June 24	Slight.	Slight.	0.20	–	–	.0518	.0432	.0316	.0116	–	.0060	.0003	0.8
6219	July 14	July 15	Dist't.	Cons.	0.55	–	–	.0106	.0570	.0356	.0214	.09	.0025	.0000	1.1
6423	Aug. 18	Aug. 20	Slight.	Cons.	0.15	–	–	.0004	.0800	.0266	.0534	–	.0030	.0001	1.1
6519	Sept. 16	Sept. 17	Dist't.	Cons.	0.15	–	–	.0000	.0446	.0210	.0236	–	.0070	.0001	–
6621	Oct. 20	Oct. 21	Slight.	Cons.	0.25	–	–	.0006	.0466	.0244	.0222	.09	.0050	.0003	1.1
6734	Nov. 17	Nov. 18	Slight.	Slight.	0.15	–	–	.0012	.0308	.0234	.0074	.12	.0070	.0001	0.8
6826	Dec. 15	Dec. 16	Dist't.	Cons.	0.10	–	–	.0016	.0420	.0260	.0160	.09	.0150	.0002	0.8
Av.	....	....	....	....	0.16	–	–	.0076	.0443	.0242	.0201	.10	.0042	.0001	0.9

Odor, generally vegetable and grassy; frequently disagreeable.——The samples were collected from near the middle of the reservoir, at from 2 to 4 feet above the bottom, with the exception of No. 5449, which was collected from the filter-dam pier. The depth of the reservoir when full is, at this point, 22 feet, but during the period from June, 1889, to December, 1890, the reservoir was kept from 2 to 11 feet below high-water mark. For heights of water at times when samples of water were collected, see page 245.

SPRINGFIELD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.											
	June.	June.	June.	June.	July.	July.	July.	July.	Aug.	Aug.	Aug.	Aug.
Day of examination,	–	11	18	25	9	16	23	30	6	13	20	31
Number of sample,	4769	4812	4847	4874	4919	4943	4966	4991	5030	5053	5079	5119
PLANTS.												
Diatomaceæ,	–	**5**	**pr.**	**1**	**7**	**0**	**0**	**42**	**174**	**44**	**244**	**52**
Asterionella,	–	1	pr.	pr.	0	0	0	8	8	0	18	0
Melosira,	–	2	pr.	1	7	0	0	34	166	44	226	50
Synedra,	–	2	0	0	0	0	0	0	0	0	0	2
Cyanophyceæ,	–	**23**	**2**	**3**	**60**	**359**	**392**	**1,276**	**702**	**750**	**920**	**846**
Anabæna,	–	20	2	1	2	41	0	0	0	0	0	6
Aphanocapsa,	–	0	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	–	0	0	0	11	0	0	0	0	0	0	0
Clathrocystis,	–	3	pr.	2	0	1	76	14	2	6	4	8
Cœlosphærium,	–	0	0	0	47	317	316	1,262	700	744	916	832
Microcystis,	–	0	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores,	–	0	0	0	0	0	0	0	0	0	0	0
Algæ,	–	**3**	**1**	**1**	**40**	**78**	**26**	**32**	**18**	**10**	**20**	**40**
Chlorococcus,	–	2	1	0	33	0	0	0	8	0	0	30
Closterium,	–	0	0	0	0	0	0	0	0	0	0	0
Cœlastrum,	–	0	0	1	4	3	0	0	0	0	0	0
Dictyosphærium,	–	0	0	0	0	4	0	0	0	0	0	0
Pediastrum,	–	pr.	pr.	pr.	0	0	2	2	2	0	0	2
Raphidium,	–	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	–	1	pr.	0	3	6	4	2	0	0	2	2
Sorastrum,	–	0	0	0	0	0	0	0	0	0	0	0
Staurastrum,	–	0	0	0	pr.	65	20	28	8	10	18	6
ANIMALS.												
Rhizopoda. Actinophrys,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	–	**0**	**0**	**0**	**pr.**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
Dinobryon,	–	0	0	0	0	0	0	0	0	0	0	0
Monas,	–	0	0	0	0	0	0	0	0	0	0	0
Peridinium,	–	0	0	0	pr.	0	0	0	0	0	0	0
Trachelomonas,	–	0	0	0	0	0	0	1	0	0	0	0
Vermes,	–	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Anurea,	–	pr.	pr.	0	0	0	0	0	0	0	0	0
Polyarthra,	–	0	0	0	0	0	0	0	0	0	0	0
Rotatorian ova,	–	0	0	0	0	0	0	0	0	0	0	0
Crustacea,	–	**pr.**	**pr.**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cyclops,	–	0	pr.	0	0	0	0	0	0	0	0	0
Daphnia,	–	pr.	pr.	0	pr.	0	0	0	0	0	0	0
TOTAL ORGANISMS,	–	31	3	5	107	437	418	1,351	894	804	1,184	938

SPRINGFIELD.

Microscopical Examination — Continued.

[Number of organisms per cubic centimeter.]

	1889.								1890.				
	Sept.	Sept.	Oct.	Oct.	Oct.	Nov.	Nov.	Dec.	Jan.	Feb.	Mar.	Mar.	April.
Day of examination,	10	17	2	12	26	12	27	18	22	15	15	28	12
Number of sample,	5157	5187	5208	5244	5281	5331	5383	5449	5552	5662	5786	5821	5876
PLANTS.													
Diatomaceæ,	**64**	**276**	**812**	**334**	**352**	**790**	**1,706**	**1,484**	**782**	**960**	**958**	**1,152**	**3,660**
Asterionella,	0	0	0	16	76	76	384	926	298	440	790	768	1,820
Melosira,	62	276	812	316	272	712	1,318	558	368	372	168	380	1,828
Synedra,	2	0	0	2	4	2	4	0	116	148	0	4	12
Cyanophyceæ,	**378**	**388**	**144**	**56**	**632**	**122**	**188**	**26**	**0**	**1**	**25**	**44**	**56**
Anabæna,	2	28	32	2	484	28	176	26	0	0	0	0	0
Aphanocapsa,	0	0	0	0	0	0	0	0	0	0	6	0	0
Chroöcoccus,	0	0	0	0	0	24	0	0	0	0	18	44	48
Clathrocystis,	140	0	4	8	32	2	0	0	0	0	0	0	4
Cœlosphærium,	236	360	92	20	100	58	12	0	0	1	1	0	4
Microcystis,	0	0	0	0	0	0	0	0	0	0	0	0	0
Nostocaceous spores,	0	0	16	26	16	0	0	0	0	0	0	0	0
Algæ,	**6**	**23**	**162**	**3,392**	**352**	**62**	**136**	**56**	**28**	**11**	**144**	**24**	**0**
Chlorococcus,	0	20	50	3,384	268	24	90	30	18	6	140	22	0
Closterium,	0	0	0	0	8	4	10	5	2	0	0	0	0
Cœlastrum,	0	1	0	2	2	0	6	0	0	0	0	0	0
Dictyosphærium,	0	0	80	0	30	8	4	1	0	0	0	0	0
Pediastrum,	4	0	6	0	0	2	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	34	4	0	0	0	0	0	0	0
Scenedesmus,	2	0	16	6	8	12	22	19	8	5	4	2	0
Sorastrum,	0	0	0	0	0	0	0	0	0	0	0	0	0
Staurastrum,	0	2	10	0	2	8	4	1	0	0	0	0	0
ANIMALS.													
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Infusoria,	**0**	**3**	**30**	**2**	**4**	**26**	**8**	**12**	**54**	**3,092**	**3,350**	**1,506**	**254**
Dinobryon,	0	0	0	0	0	18	0	3	42	3,092	3,350	1,492	244
Monas,	0	0	0	0	2	0	0	0	0	0	0	12	10
Peridinium,	0	0	0	0	0	0	6	8	12	0	0	2	0
Trachelomonas,	0	3	30	2	2	8	2	1	0	0	0	0	0
Vermes,	**0**	**3**	**0**	**0**	**0**	**0**	**2**	**4**	**3**	**2**	**0**	**4**	**0**
Anurea,	0	3	0	0	0	0	2	2	0	0	0	2	0
Polyarthra,	0	0	0	0	0	0	0	2	2	1	0	2	0
Rotatorian ova,	0	0	0	0	0	0	0	0	1	1	0	0	0
Crustacea,	**0**	**0**	**0**	**pr.**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cyclops,	0	0	0	pr.	0	0	0	0	0	0	0	0	0
Daphnia,	0	0	0	0	pr.	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	448	693	1,148	3,784	1,340	1,000	2,040	1,582	867	4,066	4,477	2,730	3,970

SPRINGFIELD.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	April.	May.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	13	31	25	15	21	17	22	19	18
Number of sample,	5910	5962	6011	6116	6219	6423	6519	6621	6734	6826
PLANTS.										
Diatomaceæ,	**4,966**	**2,488**	**240**	**78**	**168**	**1,512**	**2,034**	**726**	**855**	**856**
Asterionella,	2,632	1,800	150	13	15	8	26	204	280	520
Melosira,	2,328	676	80	65	153	1,504	2,008	520	574	316
Synedra,	6	12	10	0	0	0	0	2	1	20
Cyanophyceæ,	**52**	**42**	**111**	**323**	**275**	**2,622**	**2,156**	**85**	**965**	**66**
Anabæna,	2	34	96	315	60	0	56	3	3	0
Aphanocapsa,	0	0	0	0	0	0	38	13	12	22
Chroöcoccus,	32	0	0	0	0	108	18	5	908	4
Clathrocystis,	10	4	5	0	25	34	4	39	6	12
Cœlosphærium,	8	4	10	8	190	2,480	1,140	15	32	0
Microcystis,	0	0	0	0	0	0	0	10	4	28
Nostocaceous spores,	0	0	0	0	0	0	0	0	0	0
Algæ,	**28**	**120**	**51**	**266**	**356**	**160**	**36**	**34**	**60**	**91**
Chlorococcus,	20	108	45	0	55	4	4	15	0	0
Closterium,	0	0	0	0	0	0	0	0	0	0
Cœlastrum,	0	0	0	0	15	0	2	0	0	0
Dictyosphærium,	0	2	0	0	8	0	0	0	0	0
Pediastrum,	0	0	0	0	15	8	0	1	pr.	1
Raphidium,	0	0	0	263	50	56	0	2	0	0
Scenedesmus,	8	8	1	0	83	18	22	6	14	54
Sorastrum,	0	0	0	0	5	30	2	0	0	0
Staurastrum,	0	2	5	3	125	44	6	10	56	36
ANIMALS.										
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**7**	**40**
Infusoria,	**2**	**8**	**5**	**0**	**0**	**12**	**14**	**6**	**10**	**13**
Dinobryon,	0	2	5	0	0	0	0	0	3	5
Monas,	0	4	0	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	0	4	2	0	1	5
Trachelomonas,	2	2	0	0	0	8	12	6	6	3
Vermes,	**10**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**19**
Anurea,	6	2	0	0	0	0	0	0	0	12
Polyarthra,	0	0	0	0	0	0	0	0	2	4
Rotatorian ova,	4	0	0	0	0	0	0	0	0	3
Crustacea,	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**	**pr.**	**pr.**	**pr.**
Cyclops,	0	0	0	0	0	pr.	0	0	pr.	pr.
Daphnia,	0	0	0	0	0	0	0	pr.	0	pr.
TOTAL ORGANISMS,	5,058	2,660	407	667	799	4,306	4,240	857	1,899	1,085

SPRINGFIELD.

Table showing Heights of Water in Ludlow Reservoir at Times when Samples of Water were collected for Analysis.

NOTE. — Height of rollway, 23.00 feet.

DATE.	Height of Water.	DATE.	Height of Water.
1889.		**1889** — Con.	
June 3,	20.70	Nov. 25,	17.48
June 10,	20.63	Dec. 16,	17.88
June 17,	21.02	**1890.**	
June 24,	20.85	Jan. 20,	17.62
July 8,	20.42	Feb. 13,	17.56
July 15,	20.28	Mar. 12,	17.16
July 29,	19.94	Mar. 26,	18.05
Aug. 5,	20.22	Apr. 10,	17.61
Aug. 12,	20.04	Apr. 24,	16.77
Aug. 19,	20.12	May 12,	16.82
Aug. 30,	19.76	May 28,	16.70
Sept. 9,	19.30	June 23,	15.80
Sept. 16,	19.10	July 14,	14.55
Sept. 30,	19.02	Aug. 18,	13.37
Oct. 9,	18.85	Sept. 15,	13.20
Oct. 24,	18.10	Oct. 20,	13.05
Nov. 11,	17.59	Nov. 17,	12.75
		Dec. 15,	12.28

Chemical Examination of Water from Higher Brook, in Ludlow.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4870	June 24	June 25	V. sl't.	Slight.	0.40	–	–	.0016	.0186	.0154	.0032	–	.0030	.0001	–
5003	July 31	Aug. 1	V. sl't.	Cons.	1.70	–	–	.0022	.0494	.0442	.0052	.12	.0080	.0001	1.7
5074	Aug. 17	Aug. 19	V. sl't.	Cons.	0.55	5.25	1.44	.0014	.0228	.0166	.0062	.15	.0030	.0001	–

Odor, faintly vegetable. —— No. 4870 was collected from Higher Brook Canal where it empties into Ludlow Reservoir. No. 5003 was collected from Higher Brook, at a bridge near Chapin's Pond in Ludlow, when the brook was high on account of recent rains. No. 5074 was collected from the brook near its mouth.

SPRINGFIELD.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.		
	June.	Aug.	Aug.
Day of examination,	25	1	20
Number of sample,	4870	5003	5074
PLANTS.			
Diatomaceæ,	**4**	**4**	**14**
Melosira,	0	0	12
Navicula,	pr.	1	pr.
Synedra,	2	3	2
Tabellaria,	2	0	pr.
Fungi. Crenothrix,	**0**	**12**	**0**
Algæ. Pleurococcus,	**2**	**0**	**0**
ANIMALS.			
Infusoria,	**0**	**1**	**pr.**
Ciliated infusorian,	0	1	0
Peridinium,	0	0	pr.
TOTAL ORGANISMS,	6	17	14

Chemical Examination of Water from Broad Brook, in Belchertown.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4871	June 24	June 25	Dist't.	V. sl't.	0.35	–	–	.0022	.0226	.0190	.0036	–	.0040	.0001	–
5002	July 31	Aug. 1	V. sl't.	V. sl't.	0.80	–	–	.0008	.0270	.0270	.0000	.12	.0030	.0001	1.5
5098	Aug. 23	Aug. 24	V. sl't.	Slight.	0.40	5.65	1.65	.0014	.0166	.0136	.0030	.13	.0020	.0000	2.3
5099	Aug. 23	Aug. 24	V. sl't.	Slight.	0.50	4.20	0.95	.0016	.0140	.0116	.0024	.20	.0030	.0001	1.9

Odor, vegetable. —— Samples numbered 4871 and 5002 were collected from the upper end of Broad Brook Canal, near the Belchertown Reservoir. No. 5098 was collected from Broad Brook, above the swamp, at the head of the Belchertown Reservoir. No. 5099 from Broad Brook, where it empties into the Belchertown Reservoir.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.			
	June.	Aug.	Aug.	Aug.
Day of examination,	25	1	24	24
Number of sample,	4871	5002	5098	5099
PLANTS.				
Diatomaceæ,	3	6	5	4
Ceratoneis,	0	3	0	0
Navicula,	0	pr.	2	4
Synedra,	3	3	3	0
Fungi. Crenothrix,	2	2	24	54
ANIMALS.				
Infusoria. Peridinium,	0	pr.	0	pr.
Total Organisms,	5	8	29	58

Chemical Examination of Water from Ludlow Reservoir, Springfield Water Works, just before it is discharged into Van Horn Reservoir.

Note. — These samples were obtained to determine whether the chemical composition of the water of the Ludlow Reservoir undergoes any change as a result of the aeration which it receives where it is turned into the Van Horn Reservoir. The water flows about 12 miles through pipes from the Ludlow Reservoir and is then discharged through an 8-inch pipe into a ditch about 500 feet long in the elevated sandy plain beside the Van Horn Reservoir. After flowing through this ditch the water enters a trough having a steep grade and flows swiftly down nearly to the level of the reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5031	Aug. 5	Aug. 6	Slight.	V. sl't.	0.10	–	–	.0000	.0734	.0214	.0520	–	.0020	.0000	–
5032	Aug. 5	Aug. 6	Slight.	V. sl't.	0.10	–	–	.0000	.0776	.0222	.0554	–	.0030	.0001	–

Odor, none, vegetable when heated.——Sample No. 5031 was collected from the lower end of the trough; No. 5032 from the end of the 8-inch pipe, where it discharges into the ditch.

Microscopical Examination.

No. 5031. Diatomaceæ, *Asterionella*, 2; *Melosira*, 52; *Synedra*, 2. Cyanophyceæ, *Clathrocystis*, 4; *Cœlosphærium*, 600. Algæ, *Staurastrum*, 4. Total organisms, 664.

No. 5032. Diatomaceæ, *Asterionella*, 4; *Melosira*, 98. Cyanophyceæ, *Clathrocystis*, 12; *Cœlosphærium*, 960. Algæ, *Chlorococcus*, 16; *Scenedesmus*, 2; *Staurastrum*, 6. Total organisms, 1,098.

SPRINGFIELD.

Chemical Examination of Water from a Faucet in Springfield supplied from Ludlow Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5080	Aug. 19	Aug. 20	V. sl't.	V. sl't.	0.0	–	–	.0048	.0148	–	–	–	.0070	.0004	–

Odor, vegetable, somewhat disagreeable. —— The sample was drawn from a faucet, through a filter attached thereto, the water coming from Ludlow Reservoir.

Microscopical Examination.

No organisms.

Chemical Examination of Water from the Belchertown Reservoir, in Belchertown.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5004	July 31	Aug. 1	Slight.	Slight.	1.2	–	–	.0008	.0380	.0312	.0068	.13	.0050	.0002	1.7

Odor, vegetable and grassy. —— The sample was collected from the reservoir, at the outlet.

Microscopical Examination.

Diatomaceæ, *Melosira*, 415. Cyanophyceæ, *Clathrocystis*, 1; *Chroöcoccus*, 3. Algæ, *Eudorina*, 2; *Staurastrum*, 1. Infusoria, *Dinobryon*, 6. Vermes, *Anurea*, pr.; *Rotatorian ova*, 2. Total organisms, 430.

Chemical Examination of Water from a Well at the Gate-keeper's House, at Ludlow Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	89.										
5001	July 31	Aug. 1	None.	None.	0.0	3.90	.0000	.0028	.27	.0080	.0000	1.3

Odor, none. —— The sample was collected from the well. The temperature of the well at the time of collection was 53° F.

Microscopical Examination.

No organisms.

SPRINGFIELD.

Chemical Examination of Water from Jabish Brook, Belchertown, at proposed Point of taking by Springfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
5097	Aug. 23	Aug. 24	V. sl't.	V. sl't.	0.45	3.35	0.95	.0040	.0212	.0170	.0042	.10	.0020	.0000	0.9
5154	Sept. 9	Sept. 10	Slight.	Slight.	0.25	–	–	.0010	.0188	.0148	.0040	.12	.0020	.0000	–
	1890.														
5517	Jan. 8	Jan. 9	None.	V. sl't.	0.25	3.00	0.95	.0004	.0070	.0048	.0022	.12	.0120	.0001	0.9
Av.	....	....	....	....	0.32	3.17	0.95	.0018	.0157	.0122	.0035	.11	.0053	.0000	0.9

Odor, No. 5097, distinctly vegetable; Nos. 5154 and 5517, none.—— The samples were collected from the brook at the dam of Walker & Blackman's saw-mill.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.		1890.
	Aug.	Sept.	Jan.
Day of examination,	24	10	11
Number of sample,	5097	5154	5517
PLANTS.			
Diatomaceæ,	2	1	11
Synedra,	2	1	4
Tabellaria,	0	0	7
Fungi. Crenothrix,	33	0	pr.
ANIMALS.			
Infusoria,	75	2	0
Dinobryon,	75	1	0
Peridinium,	0	1	0
Vermes. Rotifer,	0	1	0
TOTAL ORGANISMS,	110	4	11

SPRINGFIELD.

Chemical Examination of Water from Five Mile Pond, Springfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
5520	Jan. 9	Jan. 10	V. sl't.	Cons.	0.03	2.00	0.85	.0032	.0220	.0202	.0018	.21	.0060	.0000	0.3

Odor, none. —— The sample was collected from the pond near the Boston and Albany Railroad.

Microscopical Examination.

Diatomaceæ, *Epithemia*, pr.; *Melosira*, 8; *Merismopedia*, pr.; *Navicula*, 2; *Cyclotella*, 100*; *Synedra*, 67; *Tabellaria*, 1. Cyanophyceæ, *Cœlosphærium*, pr. Algæ, *Chlorococcus*, 10; *Closterium*, pr.; *Raphidium*, 9; *Spirotænia*, 2. Infusoria, 51; *Peridinium*, 2; *Ciliated infusorian*, pr. Total organisms, 252.

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* Estimated.

Chemical Examination of Water from Burcham's Brook, in Springfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
5076	Aug. 17	Aug. 19	V. sl't.	Cons.	0.1	4.45	1.05	.0008	.0090	.0060	.0030	.12	.0070	.0001	1.9

Odor, very faintly vegetable. —— The sample was collected from the brook near its mouth.

Microscopical Examination.

Diatomaceæ, *Synedra*, pr. Fungi, *Crenothrix*, pr.

Chemical Examination of Water from Drinking Fountains in Springfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
5522	Jan. 13	Jan. 14	None.	None.	0.00	26.00	.0000	.0034	1.71	.5000	.0000	9.3
5523	Jan. 13	Jan. 14	None.	None.	0.00	23.95	.0000	.0038	1.22	.2850	.0000	9.2

Odor, none. —— Sample No. 5522 was collected from a fountain at the corner of Willow and Stockbridge streets, known as the Wesson Spring; No. 5523 from a fountain on Main Street in front of Court Square, the water coming from a spring at the corner of Maple and Stockbridge streets.

Microscopical Examination.

No organisms.

NOTE. — For examination of water from brooks in Chicopee see *Chicopee*.

WATER SUPPLY OF STOCKBRIDGE. — STOCKBRIDGE WATER COMPANY.

Chemical Examination of Water from a Faucet in Stockbridge supplied from the Works of the Stockbridge Water Company.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	89.										
4971	July 23	July 24	None.	Very slight.	0.00	–	.0000	.0026	.09	.0070	.0001	10.3

Odor, none. —— The sample was collected from a faucet in the village.

Microscopical Examination.

Diatomaceæ, *Meridion*, pr.; *Synedra*, 2.

Chemical Examination of Water from Lake Agawam, in Stockbridge.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5441	Dec. 13	Dec. 14	V. sl't.	Cons.	0.30	11.75	2.70	.0030	.0202	.0160	.0042	.10	.0080	.0002	8.6

Odor, none. —— The sample was collected from the brook flowing from the lake into Konkapot Brook.

Microscopical Examination.

Diatomaceæ, *Synedra*, pr. Algæ, *Cosmarium*, pr. Fungi, *Crenothrix*, 7. Total organisms, 7.

Chemical Examination of Water from Konkapot Brook, Stockbridge.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	89.													
5442	Dec. 13	Dec. 14	V. sl't.	Slight.	0.10	8.40	2.00	.0008	.0132	.0108	.0024	.10	.0050	.0000	6.4

Odor, faintly vegetable. —— The sample was collected from the brook near its mouth.

Microscopical Examination.

Diatomaceæ, *Meridion*, pr.; *Synedra*, 1. Rhizopoda, *Arcella*, pr.

STOCKBRIDGE.

Chemical Examination of Water from Lake Averic, in Stockbridge.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4928	July 9	July 10	Slight.	Slight.	0.10	–	–	.0012	.0226	.0178	.0048	.08	.0060	.0000	4.5
5041	Aug. 9	Aug. 9	Dist't.	Slight.	0.10	5.70	1.50	.0044	.0204	.0156	.0048	.10	.0000	.0000	3.9

Odor, No. 4928, distinctly vegetable and disagreeable; No. 5041, none. —— No. 4928 was collected from the lake at a depth of one foot beneath the surface at a point where the total depth was 12 feet; No. 5041, six feet beneath the surface, at a time when the water in the lake was very high.

Microscopical Examination.

No. 4928. Diatomaceæ, *Surirella*, pr.; *Synedra*, 7. Cyanophyceæ, *Anabœna*, 9; *Cœlosphœrium*, pr. Algæ, *Chlorococcus*, 51; *Zoöspores*, 13. Infusoria, *Dinobryon*, 120; *Euglena*, 1; *Peridinium*, 11; *Trachelomonas*, 5. Vermes, *Polyarthra*, pr. Total organisms, 217.

No. 5041. Diatomaceæ, *Synedra*, 28. Cyanophyceæ, *Anabœna*, 1; *Cœlosphœrium*, 2. Algæ, *Chlorococcus*, 17. Infusoria, *Peridinium*, 4; *Ciliated infusorian*, pr. Vermes, *Anurea*, pr.; *Polyarthra*, pr. Total organisms, 52.

WATER SUPPLY OF SWAMPSCOTT. — MARBLEHEAD WATER COMPANY.

Chemical Examination of Water from the Wells of the Marblehead Water Company, Swampscott.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6645	Oct. 27	Oct. 27	None.	None.	0.00	44.00	.0006	.0010	8.30	.6250	.0001	21.2

Odor, none. —— The sample was collected from a faucet in the pumping-station.

Microscopical Examination.

No organisms.

WATER SUPPLY OF TAUNTON.

Chemical Examination of Water from the Filter-basin of the Taunton Water Works.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4969	July 23	July 24	Slight.	None.	0.30	–	–	.0014	.0068	–	–	–	.0200	.0001	–
5084	Aug. 20	Aug. 21	Slight.	V. sl't.	0.30	–	–	.0020	.0096	.0086	.0010	–	.0250	.0001	–
5189	Sept. 17	Sept. 18	Dist't.	V. sl't.	0.25	–	–	.0014	.0074	.0060	.0014	–	.0180	.0001	–
5264	Oct. 16	Oct. 17	V. sl't.	V. sl't.	0.30	–	–	.0010	.0086	.0080	.0006	–	.0120	.0000	–
5372	Nov. 20	Nov. 21	Slight.	V. sl't.	0.30	–	–	.0014	.0080	.0056	.0024	–	.0170	.0001	–
5462	Dec 18	Dec. 19	Slight.	None.	0.05	–	–	.0022	.0038	–	–	–	.0180	.0000	–
	1890.														
5564	Jan. 23	Jan. 24	None.	None.	0.00	–	–	.0004	.0036	–	–	–	.0230	.0001	–
5703	Feb. 24	Feb. 24	V. sl't.	V. sl't.	0.10	–	–	.0010	.0020	–	–	–	.0200	.0001	–
5800	Mar. 19	Mar. 20	V. sl't.	V. sl't.	0.80	–	–	.0002	.0148	.0120	.0028	.42	.0150	.0000	–
5893	Apr. 16	Apr. 17	V. sl't.	V. sl't.	0.05	–	–	.0008	.0050	.0038	.0012	.57	.0300	.0001	–
6002	May 21	May 22	Dist't.	None.	0.30	–	–	.0006	.0102	–	–	.57	.0300	.0000	–
6128	June 25	June 26	Slight.	Slight.	0.30	–	–	.0018	.0094	.0070	.0024	.53	.0300	.0000	2.1
6275	July 22	July 23	V. sl't.	V. sl't.	0.30	5.45	–	.0028	.0078	–	–	.60	.0200	.0002	2.1
6427	Aug. 20	Aug. 21	V. sl't.	–	0.30	6.15	–	.0020	.0088	.0072	.0016	.61	.0200	.0001	1.7
6522	Sept. 17	Sept. 18	V. sl't.	V. sl't.	0.40	–	–	.0006	.0120	.0082	.0038	.58	.0170	.0000	1.4
6633	Oct. 22	Oct. 23	V. sl't.	V. sl't.	0.90	5.90	–	.0014	.0164	.0136	.0028	.60	.0120	.0002	1.8
6749	Nov. 24	Nov. 25	Slight.	Slight.	0.30	6.75	–	.0012	.0064	–	–	.61	.0350	.0001	1.9
6843	Dec. 22	Dec. 23	V. sl't.	Slight.	0.20	5.30	–	.0018	.0082	–	–	.56	.0200	.0001	2.1
Av.	....	....	....	....	0.30	5.91	–	.0013	.0083	–	–	.56	.0212	.0001	1.9

Odor, generally none, occasionally vegetable.—— The samples were collected from a faucet at the pumping-station while pumping.

TAUNTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.						1890.		
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	24	22	18	18	23	21	25	25	21
Number of sample,	4969	5084	5189	5264	5372	5462	5564	5703	5800
PLANTS.									
Diatomaceæ,	pr.	7	14	8	2	1	1	4	6
Melosira,	0	5	9	5	0	0	0	pr.	2
Navicula,	0	1	3	0	2	0	1	2	2
Synedra,	pr.	1	2	3	0	1	0	2	2
Cyanophyceæ. Oscillaria,	1	0	3	0	0	pr.	0	pr.	0
Algæ. Scenedesmus,	1	0	0	0	0	0	0	2	1
Fungi,	12	12	18	9	48	16	11	6	3
Crenothrix,	4	12	18	9	45	14	3	1	3
Leptothrix,	8	0	0	0	3	2	8	5	0
ANIMALS.									
Infusoria. Peridinium,	0	0	0	0	0	0	0	0	2
TOTAL ORGANISMS,	14	19	35	17	50	17	12	12	12

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	23	27	23	22	18	23	25	23
Number of sample,	5893	6002	6128	6275	6427	6522	6633	6749	6843
PLANTS.									
Diatomaceæ,	8	3	3	4	pr.	8	4	11	20
Melosira,	2	3	3	3	0	8	0	2	15
Navicula,	2	0	pr.	0	0	0	2	9	1
Synedra,	4	0	0	1	pr.	0	2	0	4
Cyanophyceæ, Oscillaria,	0	1	0	0	0	0	8	1	0
Algæ. Scenedesmus,	1	0	0	2	2	0	0	pr.	pr.
Fungi,	7	2	7	98	10	12	0	2	0
Crenothrix,	4	2	7	98	10	12	0	2	0
Leptothrix,	3	0	0	0	0	0	0	0	0
ANIMALS.									
Infusoria. Peridinium,	0	0	0	0	0	8	0	pr.	0
TOTAL ORGANISMS,	16	6	10	104	12	28	12	14	20

Chemical Examination of Water from the Taunton River, at Taunton.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4968	July 23	July 24	V. sl't.	Slight.	1.30	–	–	.0020	.0332	.0302	.0030	–	.0110	.0001	–
5083	Aug. 20	Aug. 21	V. sl't.	Cons.	3.00	–	–	.0018	.0462	.0412	.0050	–	.0080	.0001	–
5188	Sept. 17	Sept. 18	Slight.	Slight.	1.50	–	–	.0032	.0370	.0340	.0030	–	.0090	.0001	–
5263	Oct. 16	Oct. 17	Dist't.	Cons.	1.70	–	–	.0014	.0434	.0392	.0042	–	.0100	.0002	–
5371	Nov. 20	Nov. 21	V. sl't.	Cons.	1.80	–	–	.0016	.0232	.0216	.0016	–	.0080	.0001	–
5461	Dec. 18	Dec. 19	V. sl't.	V. sl't.	1.30	–	–	.0004	.0228	.0202	.0026	–	.0180	.0001	–
	1890.														
5563	Jan. 23	Jan. 24	Slight.	V. sl't	1.20	–	–	.0010	.0182	.0158	.0024	–	.0300	.0001	–
5702	Feb. 24	Feb. 24	Slight.	Slight.	0.90	–	–	.0002	.0168	.0152	.0016	–	.0150	.0002	–
5799	Mar. 19	Mar. 20	V. sl't.	Slight.	1.10	–	–	.0004	.0204	.0178	.0026	.38	.0090	.0000	–
5892	Apr. 16	Apr. 17	V. sl't.	Slight.	1.30	–	–	.0008	.0234	.0178	.0056	.40	.0100	.0001	–
6001	May 21	May 22	V. sl't.	Slight.	1.70	–	–	.0018	.0322	.0310	.0012	.36	.0200	.0000	–
6127	June 25	June 26	None.	Slight.	1.50	–	–	.0036	.0304	.0264	.0040	.37	.0070	.0001	–
6274	July 22	July 23	V. sl't.	Slight.	1.20	4.40	–	.0014	.0262	.0234	.0028	.49	.0040	.0002	1.3
6428	Aug. 20	Aug. 21	V. sl't.	Slight.	0.70	4.50	1.70	.0018	.0216	.0196	.0020	.57	.0060	.0001	2.1
6521	Sept. 17	Sept. 18	Slight.	Cons.	1.80	–	–	.0030	.0344	.0314	.0030	.48	.0080	.0000	1.4
6632	Oct. 22	Oct. 23	V. sl't.	Slight.	1.90	6.50	3.35	.0006	.0328	.0274	.0054	.59	.0100	.0002	1.4
6748	Nov. 24	Nov. 25	V. sl't.	Slight.	1.30	5.10	1.80	.0006	.0240	.0214	.0026	.56	.0120	.0002	1.3
6842	Dec. 22	Dec. 23	Slight, clayey.	Cons.	1.10	5.35	2.25	.0036	.0240	.0224	.0016	.57	.0100	.0002	1.1
Av.	....	....	....	....	1.46	5.36	2.27	.0016	.0283	.0253	.0030	.48	.0114	.0001	1.3

Odor, vegetable, increased on heating. —— The samples were collected from the river, opposite the filter-basin of the Taunton Water Works.

TAUNTON.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.						1890.		
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	24	22	18	18	21	21	25	25	21
Number of sample,	4968	5083	5188	5263	5371	5461	5563	5702	5799
PLANTS.									
Diatomaceæ,	1	0	0	6	3	1	1	30	5
Asterionella,	0	0	0	0	0	1	0	15	0
Melosira,	0	0	0	6	1	0	0	0	0
Synedra,	1	0	0	0	pr.	0	1	15	4
Tabellaria,	0	0	0	0	2	pr.	0	0	1
Algæ. Chlorococcus,	4	0	0	0	0	pr.	0	0	0
Fungi. Crenothrix,	2	68	112	93	12	7	3	0	6
ANIMALS.									
Infusoria,	0	0	pr.	pr.	0	pr.	0	pr.	9
Dinobryon,	0	0	pr.	0	0	0	0	0	9
Peridinium,	0	0	0	pr.	0	pr.	0	pr.	0
TOTAL ORGANISMS,	7	68	112	99	15	8	4	30	20

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	23	27	23	22	18	23	25	23
Number of sample,	5892	6001	6127	6274	6428	6521	6632	6748	6842
PLANTS.									
Diatomaceæ,	15	2	pr.	6	1	23	3	9	3
Asterionella,	12	0	0	0	0	0	0	1	2
Melosira,	0	0	0	6	0	0	3	0	0
Synedra,	3	1	pr.	0	0	0	0	2	0
Tabellaria,	0	1	pr.	0	1	23	0	6	1
Algæ. Chlorococcus,	9	pr.	2	2	0	5	0	0	0
Fungi. Crenothrix,	5	48	17	23	6	0	4	5	1
ANIMALS.									
Infusoria,	pr.	0	0	11	1	1	0	3	8
Dinobryon,	0	0	0	5	0	0	0	3	6
Peridinium,	pr.	0	0	6	1	1	0	0	2
TOTAL ORGANISMS,	29	50	19	42	8	29	7	17	12

TAUNTON.

Chemical Examination of Water from a Deep Tubular Well at Taunton.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4761	June 3	June 4	Dec'd.	Heavy, sandy.	0.00	18.10	2.30	.0020	.0090	.0050	.0040	.64	.0180	.0001	7.3

The sample was collected from an 8-inch tubular well 400 feet deep, near the filter-basin of the Taunton Water Works.

TYNGSBOROUGH.

Chemical Examination of Water from Tyng's Pond.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
5572	Jan. 30	Jan. 31	Slight.	Slight.	0.25	2.40	0.65	.0000	.0144	.0112	.0032	.19	.0060	.0000	0.5

Odor, none. —— The sample was collected from the pond, 150 feet from the shore. The pond was covered with ice about 8 inches in thickness.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 21; *Stephanodiscus*, 10; *Synedra*, 1; *Tabellaria*, 10. Algæ, *Staurastrum*, pr.; *Cœlastrum*, 2. Infusoria, *Dinobryon*, 62; *Peridinium* 1. Total organisms, 107.

Chemical Examination of Water from Long Pond.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
5573	Jan. 30	Jan. 31	Slight.	Very slight.	0.15	3.00	0.90	.0004	.0158	.0118	.0040	.22	.0060	.0001	1.1

Odor, very faint or none. —— The sample was collected from the pond, near its southerly end. The pond was covered with ice about 8 inches in thickness.

Microscopical Examination.

Infusoria, *Dinobryon*, 125; *Trachelomonas*, pr.

WAKEFIELD.

WATER SUPPLY OF WAKEFIELD AND STONEHAM. — WAKEFIELD WATER COMPANY.

Chemical Examination of Water from Crystal Lake, in Wakefield.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6562	Oct. 3	Oct. 4	Dist't.	Cons.	0.30	4.30	1.35	.0004	.0650	.0244	.0406	–	.0100	.0001	1.8
6582	Oct. 10	Oct. 11	V. sl't.	Cons.	0.20	4.40	1.25	.0000	.0254	.0176	.0078	.46	.0080	.0001	1.8
6583	Oct. 10	Oct. 11	V. sl't.	Cons.	0.25	3.95	1.45	.0000	.0208	.0150	.0058	.46	.0090	.0001	1.8

Odor, No. 6562, vegetable and disagreeable; Nos. 6582 and 6583, very faint when cold, disagreeable when heated. —— The samples were collected from the lake, Nos. 6562 and 6582 being from near the surface, and No. 6583 from near the bottom. No. 6562 was collected at a time when there was much complaint of the bad taste and odor of the water.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	Oct.	Oct.	Oct.
Day of examination,	4	11	11
Number of sample,	6562	6582	6583
PLANTS.			
Diatomaceæ,	**16**	**70**	**77**
Asterionella,	16	5	0
Melosira,	0	52	55
Stephanodiscus,	0	1	2
Tabellaria,	0	12	20
Cyanophyceæ,	**182**	**11**	**4**
Chroöcoccus,	176	0	0
Clathrocystis,	6	0	4
Cœlosphærium,	0	11	0
Algæ,	**4**	**6**	**17**
Glœocapsa,	4	0	0
Micrococcus,	0	6	17
ANIMALS.			
Rhizopoda. Actinophrys,	**2**	**3**	**0**
Infusoria,	**820**	**557**	**935**
Dinobryon,	816	555	932
Trachelomonas,	4	2	3
Vermes. Rotatorian ova,	**4**	**0**	**0**
TOTAL ORGANISMS,	1,028	647	1,033

Chemical Examination of Water from a Faucet supplied from Crystal Lake, Wakefield.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
6561	1890. Oct. 3	Oct. 4	Slight.	V. sl't.	0.20	4.15	1.20	.0000	.0234	.0184	.0050	.48	.0150	.0001	1.9

Odor, vegetable and unpleasant. —— The sample was collected from a faucet in the town at a time when there was much complaint of the bad taste and odor of the water.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 32; *Melosira*, 2; *Synedra*, 16; *Tabellaria*, 34. Cyanophyceæ, *Clathrocystis*, 44; *Chroöcoccus*, 418. Algæ, *Chlorococcus*, 6; *Staurastrum*, 2; *Glœocapsa*, 2. Infusoria, *Dinobryon*, 380. Vermes, *Anurea*, 6. Crustacea, *Cyclops*, pr.; *Daphnia*, pr. Total organisms, 942.

Chemical Examination of Water from a Spring in Boyntonville, Wakefield.

[Parts per 100,000.]

	Date of		Appearance.				Ammonia.			Nitrogen as		
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Hardness.
5120	1889. Aug. 30	Sept. 3	None.	Slight.	0.00	3.35	.0014	.0022	.40	.0500	.0000	5.8

Odor, none. —— The sample was collected from the spring, which is used as a source of water supply by several families.

Microscopical Examination.

Diatomaceæ, *Navicula*, pr.; *Synedra*, pr. Infusoria, *Synura*, pr.

WALTHAM.

WATER SUPPLY OF WALTHAM.

Chemical Examination of Water from the Filter-basin of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
5624	Feb. 11	Feb. 12	None.	Very slight.	0.00	–	.0000	.0012	.47	.0380	.0002	–

Odor, vegetable and disagreeable.—The sample was collected from the filter-basin.

Microscopical Examination.

No organisms.

Chemical Examination of Water from the Distributing Reservoir of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5625	Feb. 11	Feb. 12	Dist't.	Slight.	0.00	–	–	.0000	.0124	.0072	.0052	.47	.0280	.0001	–

Odor, none; when heated, disagreeable.—The sample was collected from the reservoir.

Microscopical Examination

Diatomaceæ, *Asterionella*, 5,120; *Synedra*, 2,630. Algæ, *Chlorococcus*, 2; *Pediastrum*, 4. Infusoria, *Dinobryon*, 6. Total organisms, 7,762.

Chemical Examination of Water from a Tubular Well near the Filter-basin of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid		Nitrates.	Nitrites.	
	1890.											
6278	July 22	July 23	Very slight.	Sl't, earthy.	0.00	15.20	.0000	.0014	.73	.1200	.0001	2.1

Odor, none.—The sample was collected from a tubular well 5 inches in diameter and 83 feet deep, located about 50 feet from the filter-basin and 20 feet from the river. Water had been pumped from the well for about ten hours previous to the collection of the sample.

Microscopical Examination.

Algæ, *Zygnema*, pr. Fungi, *Crenothrix*, 36.

Chemical Examination of Water from Charles River, at Waltham.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1890.														
6279	July 22	July 23	Slight.	Slight.	0.50	5.65	–	.0050	.0286	.0190	.0096	.45	.0020	.0003	2.3
6304	July 28	July 29	Slight.	Slight.	0.35	5.15	1.75	.0082	.0284	.0226	.0058	.47	.0020	.0003	2.2

Odor, decidedly vegetable. —— The samples were collected from the river, near the filter-basin of the Waltham Water Works.

Microscopical Examination.

No. 6279. Diatomaceæ, *Navicula*, pr.; *Synedra*, pr.; *Cyclotella*, 1. Cyanophyceæ, *Cœlosphærium*, pr.; *Oscillaria*, pr. Algæ, *Cœlastrum*, pr.; *Eudorina*, pr. Fungi, *Crenothrix*, 15. Infusoria, *Peridinium*, 1. Total organisms, 17.

No. 6304. Cyanophyceæ, *Anabœna*, 1. Algæ, *Chlorococcus*, 6; *Cœlastrum*, pr.; *Scenedesmus*, pr.; *Dictyosphærium*, pr. Fungi, *Crenothrix*, 64. Infusoria, *Peridinium*, pr. Total organisms, 71.

WATER SUPPLY OF WARE.

Chemical Examination of Water from the Well of the Ware Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1889.											
4836	June 13	June 15	None.	None.	0.0	8.45	.0000	.0020	0.99	.3750	.0001	–
4933	July 10	July 11	None.	None.	0.0	–	.0000	.0010	0.86	.3000	.0000	–
5090	Aug. 21	Aug. 22	None.	None.	0.0	–	.0000	.0008	1.00	.3250	.0000	3.3
5170	Sept. 11	Sept. 12	None.	None.	0.0	–	.0006	.0022	0.91	.3000	.0001	–
	1890.											
5631	Feb. 11	Feb. 12	None.	None.	0.0	–	.0006	.0012	1.00	.4000	.0000	–
Av.	....	....	....	....	0.0	–	.0002	.0014	0.95	.3400	.0000	–

Odor, none. —— The samples were collected from a faucet at the pumping-station, while pumping.

Microscopical Examination.

No organisms.

WARE.

Chemical Examination of Water from the Distributing Reservoir of the Ware Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1889.														
4837	June 13	June 15	Slight.	V. sl't.	0.00	8.35	-	.0038	.0128	.0074	.0054	.87	.3750	.0032	-
	1890.														
5632	Feb. 11	Feb. 12	V. sl't.	Slight.	0.00	-	-	.0006	.0038	-	-	.99	.2000	.0012	-

Odor, No. 4837, unpleasant; No. 5632, none. —— The samples were collected from the reservoir.

Microscopical Examination.

No. 4837. Algæ, *Chlorococcus*, 1. Crustacea, *Cyclops*, pr.
No. 5632. Diatomaceæ, *Synedra*, 9. Algæ, *Closterium*, 273; *Gonium*, 2. Total organisms, 284.

WASHINGTON.

Chemical Examination of Water from Brooks in Washington.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
	1889.														
5114	Aug. 28	-	-	-	0.50	-	-	-	-	-	-	.08	-	-	1.3
5115	Aug. 28	Aug. 31	V. sl't.	Slight.	1.80	5.35	2.85	.0030	.0356	.0302	.0054	.07	.0070	.0001	1.3

Odor, none, vegetable when heated. —— No. 5114 was collected from Basin Pond Brook, at the uppermost point where it is crossed by the road from Washington to Lenox Dale; No. 5115 from Roaring Brook, at the point where it is crossed by the first road below West Pond.

Microscopical Examination.

No. 5115. Fungi, *Crenothrix*, 28.

WATER SUPPLY OF WATERTOWN AND BELMONT. — WATERTOWN WATER SUPPLY COMPANY.

Chemical Examination of Water from the Filter-gallery of the Watertown Water Supply Company.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	18	90.										
6433	Aug. 22	Aug. 23	None.	None.	0.00	7.40	.0014	.0042	.69	.0450	.0000	3.9

Odor, none. —— The sample was collected from the filter-gallery.

Microscopical Examination.

No organisms.

Chemical Examination of Water from a Faucet supplied from the Tank of the Watertown Water Supply Company.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	18	90.													
6434	Aug. 22	Aug. 23	V. sl't.	Slight.	0.00	7.25	1.70	.0000	.0036	.0020	.0016	.64	.0550	.0000	4.0

Odor, none. —— The sample was collected from the second house on the line of pipe leading from the tank of the Watertown Water Supply Company, and probably represents water which had been in the tank.

Microscopical Examination.

Fungi, *Crenothrix*, 10.

WATERTOWN.

Chemical Examination of Water from the Charles River, at Watertown.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1890.														
6265	July 21	July 21	Slight.	Slight.	0.40	7.00	–	.0084	.0308	.0256	.0052	.74	.0250	.0009	2.5
6295	July 28	July 28	Dist't.	Cons.	0.25	7.90	2.65	.0286	.0400	.0330	.0070	.87	.0400	.0028	2.7

Odor, faintly vegetable. —— The samples were collected from the canal at the Ætna Mills, Watertown.

Microscopical Examination.

No. 6265. Diatomaceæ, *Synedra*, 2; *Tabellaria*, 3. Cyanophyceæ, *Anabæna*, 3; *Cœlosphærium*, pr. Algæ, *Chlorococcus*, 8. *Scenedesmus*, pr.; *Conferva*, pr.; *Sorastrum*, pr.; *Eudorina*, pr.; *Staurastrum*, pr. Fungi, *Crenothrix*, 35. Infusoria, *Peridinium*, 20. Vermes, *Rotifer*, 2. Total organisms, 73.

No. 6295. No organisms.

WATER SUPPLY OF WAYLAND.

Chemical Examination of Water from the Filter-gallery of the Wayland Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4766	June 3	June 4	V. sl't.	Slight.	0.60	5.15	–	.0024	.0174	.0154	.0020	.25	.0400	.0001	–
4804	June 7	June 8	Slight.	Slight.	0.80	–	–	.0278	.0176	.0140	.0036	.27	.0100	.0004	–
4883	June 28	June 29	Slight.	Cons.	0.80	–	–	.0116	.0260	.0234	.0026	–	–	–	–
4884	June 28	June 29	Dec'd.	Heavy.	0.40	–	–	.0318	.0208	.0162	.0046	–	–	–	–
5010	Aug. 3	Aug. 5	Dec'd.	Heavy.	0.25	–	–	.0220	.0170	.0140	.0030	–	.0100	.0002	–
5183	Sept. 15	Sept. 17	Dec'd.	Cons.	0.50	–	–	.0296	.0172	.0144	.0028	–	.0020	.0000	–
5270	Oct. 16	Oct. 17	Dist't.	Cons.	0.50	–	–	.0208	.0168	.0134	.0034	–	.0070	.0001	–
5420	Dec. 4	Dec. 5	V. sl't.	Slight.	0.05	–	–	.0036	.0064	–	–	–	.0730	.0000	–
5468	Dec. 18	Dec. 21	Slight.	Cons.	0.30	–	–	.0182	.0096	.0064	.0032	–	.0220	.0000	–
	1890.												.0230	.0000	–
5592	Feb. 4	Feb. 5	Slight.	Heavy.	0.40	–	–	.0152	.0078	–	–	–			
5773	Mar. 11	Mar. 12	Slight.	Slight.	0.60	–	–	.0146	.0076	–	–	.19	.0110	.0000	–
5957	May 7	May 8	Slight.	Cons.	0.30	–	–	.0154	.0114	.0078	.0036	.20	.0090	.0001	–
6198	July 8	July 10	Dec'd.	V. h'y.	0.20	4.00	–	.0224	.0200	.0126	.0074	.14	.0000	.0001	1.8
6569	Oct. 7	Oct. 8	Dist't.	Dec'd.	0.45	4.70	–	.0136	.0170	.0156	.0014	.21	.0120	.0001	1.7
6647	Oct. 26	Oct. 29	Slight.	Cons.	0.70	5.30	–	.0108	.0126	.0110	.0016	.37	.0500	.0002	2.1
6779	Dec. 1	Dec. 3	Dist't.	Heavy.	0.60	4.85	–	.0116	.0118	.0100	.0018	.27	.0300	.0002	1.9
Av.	....	....	....	....	0.42	4.80	–	.0175	.0138	–	–	.23	.0211	.0001	1.9

Odor, generally none, occasionally faintly vegetable. —— The samples were collected from a faucet in the gate-house supplied from the filter-gallery.

WAYLAND.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.								
	June.	June.	June.	June.	Aug.	Sept.	Oct.	Dec.	Dec.
Day of examination,	–	10	–	–	5	17	19	7	23
Number of sample,	4766	4804	4883	4884	5010	5183	5270	5420	5468
PLANTS.									
Diatomaceæ,	–	pr.	1	8	5	21	0	0	0
Asterionella,	–	0	pr.	0	5	4	0	0	0
Melosira,	–	0	1	8	0	17	0	0	0
Synedra,	–	pr.	0	pr.	0	0	0	0	0
Tabellaria,	–	0	0	pr.	0	0	0	0	0
Algæ. Chlorococcus,	–	0	0	0	0	0	0	0	0
Fungi. Crenothrix,	–	0	90	20,000	5,000*	3,500*	5,100	96	171
ANIMALS.									
Infusoria. Dinobryon,	–	0	pr.	0	0	0	0	0	0
Crustacea. Daphnia,	–	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	–	0	91	20,008	5,005	3,521	5,100	96	171

	1890.						
	Feb.	Mar.	May.	July.	Oct.	Oct.	Dec.
Day of examination,	6	15	10	10	8	30	4
Number of sample,	5592	5773	5957	6198	6569	6647	6779
PLANTS.							
Diatomaceæ,	0	0	10	0	28	0	24
Asterionella,	0	0	5	0	11	0	16
Melosira,	0	0	0	0	12	0	6
Synedra,	0	0	0	0	1	0	0
Tabellaria,	0	0	5	0	4	0	2
Algæ. Chlorococcus,	0	0	0	0	2	0	0
Fungi. Crenothrix,	2,000*	200*	900*	10,000*	3,028*	2,760	6,752
ANIMALS.							
Infusoria. Dinobryon,	0	0	0	0	239	94	8
Crustacea. Daphnia,	0	0	0	0	pr.	0	0
TOTAL ORGANISMS,	2,000	200	910	10,000	3,297	2,854	6,784

* Estimated.

WAYLAND.

Chemical Examination of Water from the Storage Reservoir of the Wayland Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4765	June 3	June 4	Slight.	Cons.	1.50	4.60	2.20	.0046	.0424	.0316	.0108	.14	.0060	.0001	–
4805	June 7	June 8	Slight.	Cons.	2.40	–	–	.0006	.0400	.0290	.0110	.18	.0040	.0002	–
4882	June 28	June 29	Slight.	Cons.	1.20	–	–	.0024	.0396	.0276	.0120	–	–	–	–
5011	Aug. 3	Aug. 5	Slight.	Cons.	1.80	–	–	.0042	.0408	.0382	.0026	–	.0030	.0001	–
5269	Oct. 16	Oct. 17	V. sl't.	Slight.	1.40	–	–	.0022	.0296	.0284	.0012	–	.0060	.0001	–
5419	Dec. 4	Dec. 5	V. sl't.	V. sl't.	0.70	–	–	.0014	.0198	.0174	.0024	–	.0180	.0002	–
5469	Dec. 18	Dec. 21	V. sl't.	Slight.	0.30	–	–	.0034	.0134	.0114	.0020	–	.0120	.0001	–
	1890.														
5591	Feb. 4	Feb. 5	V. sl't.	V. sl't.	0.70	–	–	.0004	.0148	.0110	.0038	–	.0200	.0000	–
5774	Mar. 11	Mar. 12	V. sl't.	V. sl't.	0.70	–	–	.0000	.0138	.0104	.0034	.19	.0100	.0002	–
5958	May 7	May 8	Slight.	Slight.	0.70	–	–	.0044	.0206	.0164	.0042	.18	.0050	.0000	–
6199	July 8	July 10	Dist't.	H'vy.	0.55	3.80	–	.0006	.0322	.0220	.0102	.14	.0030	.0001	1.7
6511	Sept. 14	Sept. 16	Slight.	Cons.	0.30	4.65	1.70	.0048	.0304	.0210	.0094	.23	.0050	.0001	2.2
6646	Oct. 26	Oct. 29	V. sl't.	Slight.	1.50	5.45	2.45	.0008	.0284	.0228	.0056	.32	.0090	.0002	2.1
6778	Dec. 1	Dec. 3	Slight.	Slight.	0.90	5.45	1.90	.0036	.0234	.0202	.0032	.26	.0250	.0002	1.6
Av.	....	....	....	....	0.98	5.04	2.06	.0024	.0268	.0213	.0055	.21	.0101	.0001	1.9

Odor, generally faintly vegetable, increased on heating. —— The samples were collected from the reservoir, at the surface.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.						
	June.	June.	June.	Aug.	Oct.	Dec.	Dec.
Day of examination,	–	10	–	5	19	7	23
Number of sample,	4765	4805	4882	5011	5269	5419	5469
PLANTS.							
Diatomaceæ,	–	**28**	**3**	**8**	**70**	**6**	**11**
Asterionella,	–	20	pr.	7	42	0	4
Melosira,	–	0	3	0	14	0	pr.
Navicula,	–	0	0	0	2	0	1
Synedra,	–	0	pr.	1	9	3	6
Tabellaria,	–	8	0	0	3	3	0
Algæ. Cosmarium,	–	**0**	**0**	**0**	**1**	**0**	**0**
Fungi. Crenothrix,	–	**0**	**pr.**	**27**	**pr.**	**2**	**pr.**

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1889.						
	June.	June.	June.	Aug.	Oct.	Dec.	Dec.
ANIMALS.							
Rhizopoda,	–	0	0	0	0	0	0
Actinophrys,	–	0	0	0	0	0	0
Difflugia,	–	0	0	0	0	0	0
Infusoria,	–	pr.	pr.	9	74	pr.	0
Ceratium,	–	0	0	0	0	0	0
Dinobryon,	–	pr.	pr.	9	74	0	0
Peridinium,	–	pr.	0	0	0	pr.	0
Vermes,	–	0	0	0	pr.	0	0
Polyarthra,	–	0	0	0	pr.	0	0
Rotifer,	–	0	0	0	0	0	0
Crustacea. Cyclops,	–	0	0	0	pr.	0	0
Porifera. Sponge spicules,	–	0	0	0	0	0	0
TOTAL ORGANISMS,	–	28	3	44	145	8	11

	1890.						
	Feb.	Mar.	May.	July	Sept.	Oct.	Dec.
Day of examination,	6	15	10	10	16	30	3
Number of sample,	5591	5774	5958	6199	6511	6646	6778
PLANTS.							
Diatomaceæ,	2	8	168	61	228	53	41
Asterionella,	2	5	45	0	0	27	4
Melosira,	0	0	0	25	208	6	6
Navicula,	0	0	0	3	8	2	1
Synedra,	0	3	88	25	0	10	30
Tabellaria,	0	0	35	8	12	8	pr.
Algæ. Cosmarium,	0	0	6	0	6	0	0
Fungi. Crenothrix,	2	2	0	0	0	19	pr.
ANIMALS.							
Rhizopoda,	0	0	0	0	22	0	0
Actinophrys,	0	0	0	0	18	0	0
Difflugia,	0	0	0	0	4	0	0
Infusoria,	16	pr.	4	6,803	2	977	140
Ceratium,	0	0	0	0	2	0	0
Dinobryon,	13	pr.	4	6,800	0	976	140
Peridinium,	3	0	0	3	0	1	0
Vermes,	0	0	0	0	4	1	0
Polyarthra,	0	0	0	0	2	0	0
Rotifer,	0	0	0	0	2	1	0
Crustacea. Cyclops,	0	0	0	0	8	0	0
Porifera. Sponge spicules,	0	0	0	0	2	2	0
TOTAL ORGANISMS,	20	10	178	6,864	272	1,052	181

WATER SUPPLY OF WEBSTER.

Chemical Examination of Water from Lake Chaubunagungamaug, in Webster.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1890.														
6587	Oct. 13	Oct. 14	V. sl't.	Slight.	0.02	1.80	0.65	.0002	.0144	.0110	.0034	.18	.0100	.0001	0.5

Odor, none. —— The sample was collected from the lake about opposite the end of Thompson Street, during an investigation made by the town with reference to an independent water supply.

Microscopical Examination.

Cyanophyceæ, *Chroöcoccus*, 37. Algæ, *Chlorococcus*, 2; *Glœocystis*, 33. Total organisms, 72.

Chemical Examination of Water from Ramshorn Pond, in Dudley.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1890.														
6588	Oct. 13	Oct. 14	V. sl't.	Slight.	1.20	4.15	2.25	.0014	.0306	.0254	.0052	.10	.0100	.0003	0.6

Odor, none. —— The sample was collected from the pond, which is also known as Gore's Pond and Baker's Pond, and is situated partly in Dudley and partly in Charlton. The sample was collected during an investigation made by the town of Webster with reference to an independent water supply.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 8; *Melosira*, 32; *Navicula*, 1; *Stephanodiscus*, 1; *Tabellaria*, 33. Cyanophyceæ, *Aphanocapsa*, 1. Algæ, *Raphidium*, 4. Porifera, *Sponge spicules*, 1. Total organisms, 81.

WATER SUPPLY OF WELLESLEY.

Chemical Examination of Water from the Filter-basin of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
6452	Sept. 2	Sept. 2	None.	None.	0.00	5.85	.0002	.0032	.73	.0400	.0000	4.0

Odor, none. —— The sample was collected from the filter-basin.

Microscopical Examination.

Rhizopoda, *Difflugia*, 2.

Chemical Examination of Water from Williams Spring, Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	18	90.										
6451	Sept. 2	Sept. 2	None.	None.	0.0	6.15	.0002	.0052	.73	.1000	.0001	4.3

Odor, none. —— The sample was collected from the spring.

Microscopical Examination.

Diatomaceæ, *Navicula*, pr. Algæ, *Chlorococcus*, 2.

NOTE. — For analyses of water from Waban Lake in Wellesley at various depths in August, 1889, see special report on Water Supply and Sewerage, 1890, Part I., p. 766.

WATER SUPPLY OF WESTBOROUGH.

Chemical Examination of Water from the Upper Basin, Sandra Pond, Westborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
6849	Dec. 22	Dec. 24	Slight.	Slight.	0.20	2.65	0.85	.0006	.0236	.0182	.0054	.20	.0700	.0001	0.9

Odor, none. —— The sample was collected from the upper basin, near the gate-house, at the surface. The pond was covered with ice at the time the sample was collected.

Microscopical Examination.

Diatomaceæ, *Zoöspores*, pr. Rhizopoda, *Difflugia*, pr. Infusoria, *Dinobryon*, 118; *Peridinium*, 58. Total organisms, 176.

WESTBOROUGH.

Chemical Examination of Water from the Lower Basin, Sandra Pond, Westborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6850	Dec. 22	Dec. 24	Dist'ly milky.	Cons.	0.05	3.50	0.65	.0018	.0118	.0076	.0042	.19	.0500	.0001	1.7

Odor, none. —— The sample was collected from the lower basin at Sandra Pond, Westborough, near the gate-house. This basin was only partially covered with ice at the time.

Microscopical Examination.

Algæ, *Closterium*, 12; *Zoöspores*, 4. Infusoria, *Peridinium*, 7. Total organisms, 23.

Chemical Examination of Water from a Faucet in Westborough supplied from the Westborough Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6851	Dec. 22	Dec. 24	Slight.	Slight.	0.30	2.80	0.95	.0002	.0188	.0164	.0024	.24	.0600	.0001	0.9

The sample was collected from a faucet in the village, near the railroad station.

Microscopical Examination.

Diatomaceæ, *Synedra*, pr. Algæ, *Closterium*, 12. Infusoria, *Monas*, pr.; *Peridinium*, 1. Vermes, *Anurea*, 3; *Polyarthra*, pr. Total organisms, 16.

Chemical Examination of Water from Chauncy Pond, in Westborough.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6848	Dec. 22	Dec. 24	Slight.	Cons.	0.60	4.25	1.90	.0098	.0302	.0264	.0038	.30	.0700	.0001	2.1

Odor, faintly vegetable. —— The sample was collected from the pond, near its southerly end.

Microscopical Examination.

Diatomaceæ, *Asterionella*, 6; *Nitzchia*, 35; *Stephanodiscus*, 100; *Synedra*, 38; *Tabellaria*, 748; *Striatella*, 6. Cyanophyceæ, *Anabæna*, 5; *Clathrocystis*, 6; *Chroöcoccus*, 13. Algæ, *Conferva*, 14; *Raphidium*, 54; *Scenedesmus*, 2; *Staurastrum*, pr ; *Staurogenia*, pr.; *Zoöspores*, 38. Fungi, *Micrococcus*. 700. Rhizopoda, *Difflugia*, pr.; *Actinophrys*, 7. Infusoria, *Monas*, 40; *Peridinium*, 1. Vermes, *Anurea*, pr. Crustacea, *Cyclops*, pr. Total organisms, 1,813.

WATER SUPPLY OF WEST SPRINGFIELD. — WEST SPRINGFIELD AQUEDUCT COMPANY.

Chemical Examination of Water from a Faucet in West Springfield supplied from the Works of the West Springfield Aqueduct Company.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
6280	1890. July 22	July 23	Dec'd.	Slight, green.	0.10	5.00	–	.0014	.0540	.0248	.0292	.16	.0000	.0003	1.9

Odor, decidedly vegetable and grassy. —— The sample was collected from a faucet in the second house on the pipe line below the reservoir. The reservoir was giving trouble at this time, on account of the bad taste and odor of the water.

Microscopical Examination.

Diatomaceæ, *Navicula*, 1; *Synedra*, 29; *Tabellaria*, 1. Cyanophyceæ, *Aphanocapsa*, 1,040.* Algæ, *Chroöcoccus*, 26; *Nephrocytium*, 2. Infusoria, *Peridinium*, 38; *Trachelomonas*, 6. Vermes, *Anurea*, 1. Total organisms, 1,144.

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* Estimated.

WATER SUPPLY OF WEYMOUTH.

Chemical Examination of Water from Great Pond, in Weymouth.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
4923	1889. July 8	July 10	V. sl't.	Cons.	1.40	–	–	.0000	.0230	.0220	.0010	–	.0040	.0000	–

Odor, none. —— The sample was collected from a faucet in the pumping-station, while pumping.

Microscopical Examination.

Diatomaceæ, *Epithemia*, pr.; *Melosira*, 1; *Surirella*, pr.; *Synedra*, pr. Algæ, *Chlorococcus*, 15; *Merismopedia*, 15. Fungi, *Crenothrix*, 9. Total organisms, 40.

WHITMAN.

WATER SUPPLY OF WHITMAN.

Chemical Examination of Water from the Filter-gallery of the Whitman Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4792	June 6	June 7	Dec'd.	Slight.	0.70	–	–	.0154	.0206	.0180	.0026	.57	.0200	.0004	–
4937	July 11	July 15	Dec'd.	Cons.	0.50	–	–	.0180	.0210	.0178	.0032	.68	.0050	.0002	–
5054	Aug. 13	Aug. 14	Dec'd.	Slight.	0.40	–	–	.0186	.0192	–	–	.61	.0060	.0010	–
5166	Sept. 11	Sept. 12	Dec'd.	Slight.	0.55	–	–	.0226	.0236	.0200	.0036	.66	.0030	.0013	–
5256	Oct. 15	Oct. 16	Slight.	V. sl't.	0.00	–	–	.0076	.0100	.0100	.0000	.72	.0150	.0002	–
5349	Nov. 13	Nov. 14	Slight.	V. sl't.	0.10	–	–	.0024	.0052	–	–	.78	.0230	.0001	–
5429	Dec. 10	Dec. 11	Dist't.	V. sl't.	0.05	–	–	.0010	.0100	–	–	.75	.0250	.0001	–
	1890.														
5516	Jan. 8	Jan. 9	Slight.	V. sl't.	0.00	–	–	.0002	.0054	–	–	.69	.0180	.0000	–
5622	Feb. 11	Feb. 12	Dist't.	V. sl't.	0.10	–	–	.0006	.0054	.0040	.0014	.72	.0250	.0000	–
5758	Mar. 10	Mar. 11	Slight.	None.	0.10	–	–	.0006	.0044	.0032	.0012	.69	.0250	.0000	–
5863	Apr. 9	Apr. 10	V. sl't.	None.	0.05	–	–	.0028	.0068	.0060	.0008	.68	.0120	.0001	–
5969	May 13	May 14	Dist't.	V. sl't.	0.30	–	–	.0058	.0136	–	–	.61	.0090	.0001	–
6080	June 17	June 18	Dec'd.	Slight.	0.50	–	–	.0076	.0138	–	–	.59	.0050	.0002	1.8
6214	July 14	July 15	Dist't.	Cons.	0.70	5.70	–	.0022	.0420	.0306	.0114	.58	.0010	.0000	2.1
6408	Aug 14	Aug. 15	Slight.	Cons.	0.45	5.75	–	.0054	.0322	.0270	.0052	.73	.0020	.0003	1.9
6607	Oct. 15	Oct. 16	Dist't.	Slight.	0.00	5.55	–	.0116	.0108	.0072	.0036	.67	.0080	.0002	2.3
6736	Nov. 17	Nov. 18	Dist't.	V. sl't.	0.15	5.90	–	.0072	.0060	–	–	.79	.0300	.0001	2.2
6840	Dec. 19	Dec. 19	V. sl't.	Slight.	0.40	6.20	–	.0036	.0158	.0130	.0028	.97	.0600	.0001	2.3
Av.	....	....	....	....	0.28	5.82	–	.0074	.0148	–	–	.69	.0162	.0002	2.1

Odor, generally faintly vegetable, frequently none. —— The samples were collected from the filter-gallery. At the time of collecting samples 6214 and 6408 water was being admitted to the filter-gallery from the pond, as the supply from the filter-gallery alone was insufficient for the use of the town.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	10	15	14	12	17	16	11	9	14
Number of sample,	4792	4937	5054	5166	5256	5349	5429	5516	5622
PLANTS.									
Diatomaceæ,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
Asterionella,	0	0	0	0	0	0	0	2	0
Synedra,	0	0	0	0	0	0	0	0	0
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Algæ,	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Chlorococcus,	0	9	0	0	0	0	0	0	0
Eudorina,	0	0	0	0	0	0	0	0	0
Staurastrum,	0	pr.	0	0	0	0	0	0	0
Fungi. Crenothrix,	**10**	**7**	**124**	**232**	**1**	**5**	**13**	**2**	**2**
ANIMALS.									
Infusoria,	**0**	**2**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
Dinobryon,	0	0	0	0	0	0	0	0	0
Peridinium,	0	2	0	0	0	0	0	0	0
Trachelomonas,	0	pr.	4	0	0	0	0	0	0
Vermes,	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Anurea,	0	pr.	0	0	0	0	0	0	0
Monocerca,	0	0	0	0	0	0	0	0	0
Rotifer,	0	0	0	0	0	0	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	10	18	128	232	1	5	13	4	2

	1890.								
	Mar.	April.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
Day of examination,	12	11	14	18	15	18	17	21	22
Number of sample,	5758	5863	5969	6080	6214	6408	6607	6736	6840
PLANTS.									
Diatomaceæ,	**0**	**0**	**4**	**0**	**144**	**4**	**0**	**0**	**2**
Asterionella,	0	0	1	0	44	0	0	0	0
Synedra,	0	0	3	0	100	4	0	0	2
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**0**	**0**	**48**	**0**	**5**	**0**	**0**
Algæ,	**0**	**0**	**0**	**0**	**88**	**20**	**0**	**0**	**0**
Chlorococcus,	0	0	0	0	64	20	0	0	0
Eudorina,	0	0	0	0	14	0	0	0	0
Staurastrum,	0	0	0	0	10	0	0	0	0
Fungi. Crenothrix,	**5**	**0**	**9**	**40***	**66**	**24**	**0**	**0**	**42**

* Estimated.

WHITMAN.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	Mar.	April.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
ANIMALS.									
Infusoria,	**0**	**0**	**0**	**0**	**16**	**0**	**pr.**	**0**	**21**
Dinobryon,	0	0	0	0	0	0	0	0	21
Peridinium,	0	0	0	0	4	0	0	0	0
Trachelomonas,	0	0	0	0	12	0	pr.	0	0
Vermes,	**0**	**0**	**0**	**0**	**16**	**2**	**0**	**0**	**0**
Anurea,	0	0	0	0	8	2	0	0	0
Monocerca,	0	0	0	0	4	0	0	0	0
Rotifer,	0	0	0	0	4	0	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	5	0	13	40	378	50	5	0	65

Chemical Examination of Water from Hobart's Pond, in Whitman.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4791	June 6	June 7	Dist't.	Cons.	1.30	–	–	.0036	.0540	.0446	.0094	.54	.0040	.0002	–
4931	July 10	July 11	Slight.	Cons.	1.10	–	–	.0044	.0520	.0438	.0082	.61	.0020	.0000	–
5055	Aug. 13	Aug. 14	Slight.	Cons.	1.00	–	–	.0042	.0476	.0340	.0136	.64	.0020	.0001	–
5167	Sept. 11	Sept. 12	V. sl't.	Slight.	1.10	–	–	.0044	.0484	.0400	.0084	.68	.0030	.0000	–
5255	Oct. 15	Oct. 16	V. sl't.	Slight.	0.90	–	–	.0028	.0318	.0274	.0044	.88	.0030	.0001	–
5348	Nov. 13	Nov. 14	Slight.	Slight.	1.00	–	–	.0046	.0286	.0256	.0030	.90	.0060	.0002	–
5428	Dec. 10	Dec. 11	V. sl't.	Slight.	0.90	–	–	.0042	.0262	.0238	.0024	.77	.0150	.0002	–
	1890.														
5515	Jan. 8	Jan. 9	Slight.	Slight.	0.50	–	–	.0020	.0216	.0182	.0034	.76	.0240	.0001	–
5623	Feb. 11	Feb. 12	Dist't.	Slight.	0.50	–	–	.0004	.0284	.0178	.0106	.74	.0250	.0001	–
5757	Mar. 10	Mar. 11	V. sl't.	V. sl't.	0.55	–	–	.0002	.0274	.0206	.0068	.74	.0200	.0002	–
5862	Apr. 9	Apr. 10	Slight.	Cons.	0.40	–	–	.0028	.0240	.0202	.0038	.55	.0150	.0001	–
5968	May 13	May 14	Slight.	Slight.	1.00	–	–	.0058	.0296	.0264	.0032	.45	.0090	.0001	–
6079	June 17	June 18	Slight.	Slight.	0.90	–	–	.0054	.0372	.0342	.0030	.48	.0150	.0001	1.7
6213	July 14	July 15	Dist't.	Cons.	0.70	5.95	–	.0008	.0412	.0340	.0072	.58	.0000	.0000	2.3
6407	Aug. 14	Aug. 15	Dist't.	Cons., rusty.	0.45	5.85	2.75	.0014	.0508	.0332	.0176	.67	.0020	.0002	2.5
6608	Oct. 15	Oct. 16	V. sl't.	Slight.	0.90	6.30	2.00	.0018	.0380	.0322	.0058	.72	.0250	.0006	1.8
6735	Nov. 17	Nov. 18	Slight.	Cons.	0.90	5.75	2.10	.0050	.0316	.0268	.0048	.89	.0180	.0001	1.8
6839	Dec. 19	Dec. 19	Dist't.	Slight.	0.50	6.55	3.30	.0038	.0210	.0186	.0024	1.00	.0520	.0003	2.1
Av.	....	....	....	....	0.81	6.11	2.54	.0032	.0355	.0289	.0066	.70	.0133	.0001	2.0

Odor, vegetable, when heated frequently disagreeable.—— The samples were collected from the pond, near the surface.

WHITMAN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	10	11	14	12	17	13	11	9	14
Number of sample,	4791	4931	5055	5167	5255	5348	5428	5515	5623
PLANTS.									
Diatomaceæ,	**4**	**10**	**6**	**14**	**4**	**5**	**11**	**19**	**10**
Asterionella,	0	4	0	0	0	0	0	1	0
Melosira,	0	pr.	0	0	0	1	3	0	0
Navicula,	0	0	0	2	pr.	0	0	0	0
Nitzchia,	0	0	0	0	0	0	0	0	0
Synedra,	pr.	4	4	12	2	2	4	6	2
Tabellaria,	4	2	2	0	2	2	4	12	8
Algæ,	**1**	**124**	**62**	**26**	**0**	**pr.**	**0**	**0**	**3**
Chlorococcus,	0	111	34	21	0	0	0	0	3
Cosmarium,	0	2	0	0	0	0	0	0	0
Eudorina,	0	5	3	1	0	0	0	0	0
Raphidium,	0	0	25	0	0	0	0	0	0
Scenedesmus,	0	0	0	2	0	pr.	0	0	0
Staurastrum,	1	6	0	2	0	0	0	0	0
Fungi,	**5**	**0**	**6**	**10**	**4**	**12**	**11**	**18**	**8**
Crenothrix,	5	0	6	10	4	12	11	3	7
Leptothrix,	0	0	0	0	0	0	0	15	1
ANIMALS.									
Infusoria,	**5**	**34**	**12**	**56**	**305**	**170**	**26**	**4**	**76**
Ciliated infusorian,	0	0	3	0	0	0	0	0	0
Dinobryon,	pr.	0	pr.	40	305	168	26	4	71
Euglena,	5	7	0	0	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	0	0
Peridinium,	0	10	5	pr.	0	0	pr.	0	5
Phacus,	0	5	pr.	2	0	0	0	0	0
Synura,	pr.	0	2	0	pr.	2	0	0	0
Tintinnidium,	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	12	2	14	0	0	0	0	0
Vermes,	**0**	**pr.**	**5**	**4**	**2**	**0**	**0**	**0**	**0**
Anurea,	0	pr.	4	1	0	0	0	0	0
Monocerca,	0	0	0	pr.	0	0	0	0	0
Polyarthra,	0	pr.	pr.	1	0	0	0	0	0
Rotatorian ova,	0	0	1	2	2	0	0	0	0
Crustacea. Cyclops,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	15	168	91	110	315	187	48	41	97

WHITMAN.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	Mar.	April.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
Day of examination,	12	11	14	18	15	18	17	21	22
Number of sample,	5757	5862	5968	6079	6213	6407	6608	6735	6839
PLANTS.									
Diatomaceæ,	**pr.**	**17**	**pr.**	**1**	**552**	**688**	**0**	**143**	**4**
Asterionella,	0	8	pr.	0	12	0	0	0	0
Melosira,	0	0	0	0	0	4	0	5	0
Navicula,	pr.	0	0	0	0	0	0	24	pr.
Nitzchia,	0	0	0	0	0	0	0	12	0
Synedra,	pr.	9	0	1	540	656	0	74	4
Tabellaria,	0	0	0	0	0	28	0	28	0
Algæ,	**0**	**4**	**0**	**2**	**984**	**152**	**pr.**	**pr.**	**pr.**
Chlorococcus,	0	4	0	2	944	100	0	0	0
Cosmarium,	0	0	0	0	0	10	0	pr.	0
Eudorina,	0	0	0	0	2	0	0	0	0
Raphidium,	0	0	0	0	24	0	0	0	0
Scenedesmus,	0	0	0	0	2	6	0	6	pr.
Staurastrum,	0	0	0	0	12	36	pr.	pr.	0
Fungi,	**11**	**7**	**9**	**7**	**2**	**0**	**34**	**120**	**36**
Crenothrix,	11	7	7	7	2	0	34	120	36
Leptothrix,	0	0	2	0	0	0	0	0	0
ANIMALS.									
Infusoria,	**0**	**5**	**6**	**19**	**38**	**38**	**39**	**6**	**310**
Ciliated infusorian,	0	0	0	0	0	0	0	0	0
Dinobryon,	0	0	5	pr.	0	0	39	2	290
Euglena,	0	0	0	0	0	6	0	0	0
Monas,	0	0	0	9	0	0	0	2	0
Peridinium,	0	3	1	0	24	4	0	1	4
Phacus,	0	0	0	0	0	14	0	0	0
Synura,	0	2	0	10	0	0	0	0	16
Tintinnidium,	0	0	0	0	4	0	0	0	0
Trachelomonas,	0	pr.	0	0	10	14	pr.	1	0
Vermes,	**0**	**0**	**pr.**	**0**	**8**	**4**	**0**	**0**	**0**
Anurea,	0	0	pr.	0	0	0	0	0	0
Monocerca,	0	0	0	0	8	0	0	0	0
Polyarthra,	0	0	0	0	0	4	0	0	0
Rotatorian ova,	0	0	0	0	0	0	0	0	0
Crustacea. Cyclops,	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**pr.**	**0**
TOTAL ORGANISMS,	11	33	15	29	1,584	888	73	269	350

WILLIAMSTOWN.

Water Supply of Williamstown. — Williamstown Aqueduct Company.

Chemical Examination of Water from Cold Spring, Williamstown.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.	
	1890.											
6363	Aug. 5	Aug. 6	None.	None.	0.00	14.20	.0000	.0012	.05	.0500	.0001	14.0

Odor, none.—— The sample was collected from the spring originally used by the Williamstown Aqueduct Company.

Microscopical Examination.

Diatomaceæ, *Synedra*, 2. Algæ, *Chlorococcus*, 4.

Water Supply of Winchester.

*Chemical Examination from a Faucet in Winchester supplied from the Winchester Water Works.**

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4770	June 4	June 4	Slight.	Slight.	0.15	–	–	.0012	.0204	.0158	.0046	.48	.0150	.0003	–
4814	June 11	June 12	Dist't.	Cons.	0.05	–	–	.0018	.0274	.0202	.0072	–	.0050	.0001	–
4901	July 2	July 2	Dist't.	Cous.	0.05	–	–	.0010	.0258	.0200	.0058	–	.0050	.0000	–
5036	Aug. 6	Aug. 7	V. sl't.	Slight.	0.00	–	–	.0002	.0192	.0168	.0024	–	.0040	.0000	–
5143	Sept. 4	Sept. 5	Slight.	V. sl't.	0.10	–	–	.0002	.0216	.0182	.0034	–	.0020	.0001	–
5225	Oct. 3	Oct. 4	V. sl't.	V. sl't.	0.30	–	–	.0036	.0228	.0194	.0034	–	.0060	.0001	–
5313	Nov. 6	Nov. 6	V. sl't.	V. sl't.	0.25	–	–	.0036	.0178	.0146	.0032	–	.0180	.0007	–
5405	Dec. 3	Dec. 4	Dist't.	Cons.	0.10	–	–	.0024	.0222	.0184	.0038	–	.0140	.0004	–
	1890.														
5498	Jan. 3	Jan. 3	Slight.	V. sl't.	0.05	–	–	.0020	.0174	.0140	.0034	–	.0200	.0001	–
5600	Feb. 5	Feb. 7	Sllght.	Slight.	0.35	–	–	.0028	.0144	.0118	.0026	–	.0200	.0006	–
5739	Mar. 4	Mar. 5	Dist't.	Cons.	0.10	–	–	.0002	.0182	.0152	.0030	.55	.0150	.0002	–
5853	Apr. 7	Apr. 8	V. sl't.	Slight, rusty.	0.05	–	–	.0016	.0186	.0130	.0056	.53	.0250	.0001	–
5943	May 5	May 5	Slight.	Slight.	0.03	–	–	.0024	.0228	.0128	.0100	.47	.0150	.0002	–
6030	June 3	June 3	Slight.	Slight.	0.10	5.10	1.35	.0020	.0192	.0136	.0056	.54	.0050	.0001	2.6
6146	July 1	July 1	Dist't.	Cons.	0.05	5.85	–	.0014	.0190	.0158	.0032	.50	.0035	.0000	2.7
6336	Aug. 4	Aug. 4	V. sl't.	V. sl't.	0.00	5.35	1.35	.0026	.0226	.0180	.0046	.52	.0130	.0001	2.8
6468	Sept. 3	Sept. 3	Slight.	Slight.	0.10	5.20	1.30	.0018	.0242	.0212	.0030	.53	.0125	.0000	–
6564	Oct. 6	Oct. 7	Slight.	Slight.	0.08	5.10	1.10	.0004	.0252	.0186	.0066	.50	.0150	.0001	2.5
6688	Nov. 4	Nov. 5	V. sl't.	V. sl't.	0.10	5.50	1.40	.0018	.0172	.0170	.0002	.55	.0200	.0001	2.7
6777	Dec. 2	Dec. 3	Slight.	V. sl't.	0.10	5.55	1.35	.0012	.0228	.0212	.0016	.54	.0200	.0003	3.0
Av.	....	....	....	....	0.11	5.30	1.31	.0017	.0208	.0167	.0041	.52	0128	.0002	2.7

Odor, generally vegetable, sometimes unpleasant, particularly when heated.—— The samples were collected from a faucet in the village.

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* See also page 279.

WINCHESTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.								1890.	
	June.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Day of examination,	–	12	3	7	7	5	7	4	4	8
Number of sample,	4770	4814	4901	5036	5143	5225	5313	5405	5498	5600
PLANTS.										
Diatomaceæ,	–	**1**	**3**	**24**	**104**	**101**	**448**	**757**	**647**	**571**
Asterionella,	–	0	0	0	28	44	294	694	626	540
Stephanodiscus,	–	0	0	0	pr.	1	6	19	16	17
Synedra,	–	pr.	0	0	0	0	2	1	0	pr.
Tabellaria,	–	1	3	24	76	56	146	43	5	14
Cyanophyceæ,	–	**pr.**	**325**	**0**	**79**	**4**	**1**	**1**	**0**	**0**
Anabæna,	–	0	0	0	0	2	0	0	0	0
Aphanocapsa,	–	0	26	0	75	0	0	0	0	0
Chroöcoccus,	–	0	293	0	0	0	0	0	0	0
Cœlosphærium,	–	pr.	6	0	4	2	1	1	0	0
Algæ,	–	**55**	**47**	**9**	**13**	**0**	**16**	**0**	**4**	**3**
Chlorococcus,	–	55	47	9	13	0	16	0	4	3
Cœlastrum,	–	0	0	0	0	0	0	0	0	0
ANIMALS.										
Infusoria,	–	**0**	**0**	**351**	**115**	**23**	**0**	**2**	**8**	**32**
Ciliated infusorian,	–	0	0	0	0	0	0	0	0	0
Dinobryon,	–	0	0	351	114	16	0	2	8	32
Peridinium,	–	0	0	0	1	2	0	0	0	0
Trachelomonas,	–	0	0	0	pr.	5	0	0	0	0
Vermes. Anuræa,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**pr.**
Porifera. Sponge spicules,	–	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL ORGANISMS,	–	56	375	384	311	128	465	760	659	606

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	8	6	5	2	5	3	7	5	3
Number of sample,	5739	5853	5943	6030	6146	6336	6468	6564	6688	6777
PLANTS.										
Diatomaceæ,	**297**	**473**	**166**	**247**	**16**	**4**	**0**	**0**	**27**	**128**
Asterionella,	280	425	54	71	0	0	0	0	17	62
Stephanodiscus,	13	30	68	169	11	2	0	0	6	60
Synedra,	1	6	19	1	5	2	0	0	4	6
Tabellaria,	3	12	25	6	0	0	0	0	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS — Con.										
Cyanophyceæ,	**0**	**0**	**pr.**	**0**	**4**	**16**	**68**	**39**	**11**	**3**
Anabæna,	0	0	pr.	0	0	0	11	0	0	0
Aphanocapsa,	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	15	0	0	3	0
Cœlosphærium,	0	0	pr.	0	4	1	57	39	8	3
Algæ,	**3**	**2**	**12**	**192**	**2,212**	**23**	**1**	**41**	**0**	**0**
Chlorococcus,	3	2	12	144	2,148	23	1	41	0	0
Cœlastrum,	0	0	0	48	64	0	0	0	0	0
ANIMALS.										
Infusoria,	**81**	**19**	**3**	**196**	**3**	**4**	**0**	**356**	**7**	**pr.**
Ciliated infusorian,	2	pr.	0	0	0	0	0	0	0	0
Dinobryon,	78	19	1	196	0	0	0	353	3	pr.
Peridinium,	1	0	0	0	1	2	0	0	0	pr.
Trachelomonas,	0	0	2	pr.	2	2	0	3	4	0
Vermes. Anurea,	**2**	**0**	**pr.**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
TOTAL ORGANISMS,	383	494	181	635	2,235	47	70	437	46	131

*Chemical Examination of Water from the Winchester Water Works in June, 1889.**

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Exam-ination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
	1889.														
4825	June 12	June 13	Slight.	Cons.	0.15	–	–	.0030	.0250	.0192	.0058	.50	.0000	.0000	–
4826	June 12	June 13	Slight.	Cons.	0.05	–	–	.0002	.0256	.0202	.0054	.50	.0020	.0000	–
4827	June 12	June 13	Slight.	Slight.	0.05	–	–	.0030	.0226	.0202	.0024	.49	.0040	.0001	–
4854	June 19	June 20	Slight.	Slight.	0.05	–	–	.0010	.0256	.0214	.0042	–	.0020	.0000	–
4855	June 19	June 20	Dist't.	Slight.	0.05	–	–	.0010	.0284	.0232	.0052	–	.0020	.0000	–
4856	June 19	June 20	Slight.	V. sl't.	0.05	–	–	.0002	.0222	.0196	.0026	–	.0030	.0001	–
4876	June 25	June 26	Dist't.	Cons.	0.05	–	–	.0000	.0290	.0186	.0104	–	.0020	.0000	–
4877	June 25	June 26	Dist't.	Slight.	0.05	–	–	.0000	.0288	.0248	.0040	–	.0020	.0000	–
4878	June 25	June 26	Dist't.	Slight.	0.00	–	–	.0000	.0244	.0166	.0078	–	.0030	.0001	–

Odor, distinctly vegetable, occasionally unpleasant. —— Samples numbered 4825, 4854, 4855 and 4876 were collected from the north reservoir, at the surface and about 150 feet from the gate-house, at the deepest part of the reservoir; No. 4826 was collected at the same point 13 feet beneath the surface, and No. 4877 at the same point 6 feet beneath the surface. Nos. 4827, 4856 and 4878 were collected from a faucet in the village.

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* See also page 277.

WINCHESTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.								
	June.	June.	June.	June.	June.	June.	June.	June.	June.
Day of examination,	13	13	13	20	22	20	26	26	26
Number of sample,	4825	4826	4827	4854	4855	4856	4876	4877	4878
PLANTS.									
Diatomaceæ. Tabellaria,	3	pr.	2	pr.	1	1	pr.	5	3
Cyanophyceæ,	5	10	pr.	pr.	4	2	6	404	401
Anabæna,	5	10	pr.	0	0	0	0	0	0
Aphanocapsa,	pr.	0	0	pr.	3	1	1	4	1
Chroöcoccus,	0	0	0	0	1	1	5	400	400
Algæ,	127	151	101	252	403	160	0	3	2
Chlorococcus,	125	150	100	250	400	160	0	pr.	2
Staurogenia,	2	1	1	2	3	pr.	0	3	pr.
Fungi. Leptothrix,	8	pr.	0	0	0	0	pr.	0	0
ANIMALS.									
Crustacea,	pr.	pr.	0	0	0	0	0	pr.	0
Cyclops,	pr.	0	0	0	0	0	0	pr.	0
Daphnia,	0	pr.	0	0	0	0	0	0	0
TOTAL ORGANISMS,	143	161	103	252	408	163	6	412	406

Chemical Examination of Water from a Spring below Winter Pond, in Winchester.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	18	89.													
4865	June 21	June 21	Slight.	Slight.	0.03	3.65	0.20	.0048	.0082	.0068	.0014	.42	.0020	.0001	–

Odor, vegetable and unpleasant. —— The sample was collected from a spring in a valley about 300 feet from Winter Pond and below it, and is mainly composed of water flowing underground from the pond.

Microscopical Examination.

Fungi, *Crenothrix*, 2; *Leptothrix*, 1,200.

WATER SUPPLY OF WOBURN.

Chemical Examination of Water from the Filter-gallery of the Woburn Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1889.											
4790	June 6	June 6	None.	None.	0.00	–	.0016	.0020	2.07	.0300	.0000	–
4925	July 9	July 10	None.	None.	0.00	–	.0022	.0026	–	.0400	.0000	–
5044	Aug. 12	Aug. 12	None.	None.	0.00	–	.0010	.0028	2.05	.0300	.0000	–
5150	Sept. 9	Sept. 9	None.	None.	0.00	–	.0016	.0026	2.00	.0280	.0000	–
5231	Oct. 8	Oct. 8	None.	None.	0.00	–	.0016	.0016	2.07	.0250	.0000	–
5320	Nov. 7	Nov. 8	None.	None.	0.00	–	.0002	.0006	2.06	.0300	.0000	–
5417	Dec. 4	Dec. 5	None.	Very slight.	0.00	–	.0014	.0024	1.99	.0380	.0001	–
	1890.											
5555	Jan. 21	Jan. 21	Very slight.	None.	0.00	–	.0000	.0022	1.90	.0480	.0001	–
5608	Feb. 7	Feb. 8	Very slight.	None.	0.00	–	.0000	.0014	1.90	.0400	.0000	–
5749	Mar. 5	Mar. 6	Very slight.	None.	0.00	–	.0006	.0018	1.87	.0500	.0000	–
5856	Apr. 7	Apr. 9	None.	None.	0.00	–	.0018	.0028	1.77	.0480	.0000	–
5945	May 5	May 6	None.	None.	0.00	–	.0008	.0008	1.71	.0400	.0001	–
6032	June 3	June 4	Very slight.	Very slight.	0.00	–	.0018	.0022	1.82	.0600	.0000	4.8
6190	July 8	July 9	None.	None.	0.00	–	–	–	1.86	–	–	–
6374	Aug. 6	Aug. 7	None.	None.	0.00	11.20	.0028	.0056	2.00	.0650	.0000	5.2
6489	Sept. 9	Sept. 10	None.	None.	0.10	–	–	–	2.10	–	–	–
6590	Oct. 14	Oct. 15	None.	None.	0.00	11.45	.0014	.0020	1.97	.0280	.0001	4.9
6698	Nov. 5	Nov. 6	None.	None.	0.00	11.10	.0012	.0016	2.19	.0520	.0001	5.1
6794	Dec. 8	Dec. 9	None.	None.	0.00	10.50	.0012	.0028	1.82	.0500	.0000	5.1
Av.	....	....	....	....	0.01	11.06	.0012	.0022	1.95	.0413	.0000	5.0

Odor, none. —— The samples were collected from a faucet in the pumping-station, while pumping, with the exception of No. 5417, which was collected from the pump-well when the pumps were not running.

WOBURN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	10	12	10	0	0	7	22	8	7
Number of sample,	4790	4925	5044	5150	5231	5320	5417	5555	5608	5749
PLANTS.										
Diatomaceæ,	pr.	2	3	0	0	0	0	365	216	pr.
Asterionella,	0	0	0	0	0	0	0	248	198	pr.
Stephanodiscus,	pr.	0	0	0	0	0	0	117	0	0
Synedra,	0	0	0	0	0	0	0	0	18	0
Algæ. Closterium,	0	0	0	0	0	0	0	52	54	79
Fungi. Crenothrix,	0	0	0	0	0	0	0	0	0	0
ANIMALS.										
Infusoria. Monas,	0	0	0	0	0	0	0	2	11	0
TOTAL ORGANISMS,	0	0	0	0	0	0	0	419	281	79

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	9	6	7	-	9	10	16	8	9
Number of sample,	5856	5945	6032	6190	6374	6489	6590	6698	6794
PLANTS.									
Diatomaceæ,	0	0	2	-	0	pr.	0	0	pr.
Asterionella,	0	0	0	-	0	0	0	0	0
Stephanodiscus,	0	0	pr.	-	0	0	0	0	0
Synedra,	0	0	2	-	0	pr.	0	0	pr.
Algæ. Closterium,	0	0	0	-	0	0	0	0	0
Fungi. Crenothrix,	0	0	0	-	0	5	5	0	0
ANIMALS.									
Infusoria. Monas,	0	0	0	-	0	0	0	0	0
TOTAL ORGANISMS,	0	0	2	-	0	5	5	0	0

WOBURN.

Chemical Examination of Water from Horn Pond, in Woburn.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4789	June 6	June 6	Slight.	Slight.	0.50	–	–	.0028	.0314	.0246	.0068	1.81	.0300	.0013	–
4924	July 9	July 10	Dist't.	Heavy.	0.30	–	–	.0000	.0476	.0242	.0234	2.19	.0180	.0013	–
5043	Aug. 12	Aug. 13	Dist't.	Cons.	0.40	–	–	.0020	.0550	.0272	.0278	2.25	.0020	.0004	–
5149	Sept. 9	Sept. 9	Dec'd.	Slight.	0.30	–	–	.0004	.0688	.0296	.0392	2.32	.0110	.0014	–
5230	Oct. 8	Oct. 8	Slight.	Slight.	0.25	–	–	.0202	.0450	.0260	.0190	2.45	.0100	.0014	–
5319	Nov. 7	Nov. 8	Dist't.	Cons.	0.50	–	–	.0288	.0362	.0226	.0136	2.48	.0360	.0022	–
5416	Dec. 4	Dec. 5	Slight.	Slight.	0.30	–	–	.0192	.0278	.0210	.0068	1.98	.0400	.0015	–
	1890.														
5554	Jan. 21	Jan. 21	Slight.	Slight.	0.40	–	–	.0108	.0194	.0158	.0036	1.54	.0900	.0009	–
5607	Feb. 7	Feb. 8	Slight.	Slight.	0.35	–	–	.0042	.0198	.0142	.0056	1.53	.0850	.0010	–
5748	Mar. 5	Mar. 6	Dist't.	Cons.	0.30	–	–	.0058	.0186	.0110	.0076	1.57	.0900	.0011	–
5755	Mar. 7	Mar. 8	Dist't.	Heavy.	0.30	–	–	.0110	.0250	.0148	.0102	1.68	.1200	.0008	–
5855	Apr. 7	Apr. 9	Dec'd.	Cons.	0.20	–	–	.0022	.0296	.0144	.0152	1.34	.0600	.0007	–
5944	May 5	May 6	Dist't.	Heavy.	0.20	–	–	.0026	.0172	.0138	.0034	1.47	.0900	.0009	–
6031	June 3	June 4	Dist't.	Slight.	0.30	–	–	.0038	.0444	.0202	.0242	1.52	.0350	.0012	2.9
6189	July 8	July 9	Dec'd.	Cons.	0.10	9.30	–	.0140	.0632	.0314	.0318	1.93	.0030	.0004	3.8
6373	Aug. 6	Aug. 7	Dec'd.	Heavy.	0.20	10.90	2.05	.0012	.0644	.0358	.0286	2.59	.0050	.0000	3.5
6488	Sept. 9	Sept. 10	Dec'd.	Cons.	0.10	10.95	1.80	.0000	.0666	.0264	.0402	2.70	.0100	.0002	3.5
6589	Oct. 14	Oct. 15	Slight.	Heavy.	0.25	11.25	2.20	.0006	.0534	.0230	.0304	2.81	.0120	.0002	3.5
6697	Nov. 5	Nov. 6	V. sl't.	Slight.	0.45	10.40	2.15	.0258	.0276	.0216	.0060	2.30	.0450	.0014	3.2
6795	Dec. 8	Dec. 9	Slight.	Slight.	0.40	10.30	2.15	.0226	.0286	.0242	.0044	1.82	.1100	.0013	3.6
Av.	....	....	....	....	0.31	10.76	2.07	.0088	.0402	.0225	.0177	2.03	.0412	.0010	3.4

Odor, distinctly vegetable, frequently grassy, increased on heating.——The samples were collected from the pond at the southerly end, 20 to 50 feet from shore, and four feet beneath the surface, at a point where the water was from 16 to 20 feet in depth, excepting as follows: No. 5416 was collected off the bulk head, near the shore; No. 5755 was collected 300 feet from shore and two feet above the bottom of the pond, at a point where the water was 28 feet in depth.

WOBURN.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	10	10	12	10	9	9	7	22	8	7
Number of sample,	4789	4924	5043	5149	5230	5319	5416	5554	5607	5748
PLANTS.										
Diatomaceæ,	**340**	**193**	**124**	**0**	**80**	**333**	**360**	**896**	**3,447**	**5,441**
Asterionella,	320	0	0	0	10	227	312	746	3,350	5,415
Cocconeis,	0	0	0	0	0	0	0	0	0	0
Fragillaria,	0	0	0	0	0	0	0	0	0	0
Melosira,	0	0	0	0	4	32	14	6	52	16
Navicula,	0	0	0	0	0	0	0	0	0	0
Nitzchia,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	pr.	0	1	0	0	4	2	132	pr.	0
Synedra,	20	193	123	0	61	70	32	12	45	10
Tabellaria,	0	0	0	0	5	0	0	0	0	0
Cyanophyceæ,	**0**	**116**	**544**	**776**	**606**	**4**	**2**	**0**	**0**	**0**
Anabæna,	0	81	326	728	595	0	0	0	0	0
Clathrocystis,	0	23	78	46	11	2	0	0	0	0
Cœlosphærium,	0	12	140	2	0	2	2	0	0	0
Nostocaceous spores,	0	0	0	0	0	0	0	0	0	0
Algæ,	**191**	**280**	**117**	**2**	**22**	**18**	**24**	**3**	**12**	**0**
Chlorococcus,	160	195	106	0	6	3	10	0	10	0
Closterium,	0	0	0	0	0	0	2	0	0	0
Cœlastrum,	0	12	0	0	0	1	4	pr.	0	0
Cosmarium,	0	0	0	0	7	2	0	0	0	0
Pediastrum,	1	6	0	0	0	4	pr.	0	0	0
Polyedrium,	0	0	0	0	0	0	0	0	0	0
Raphidium,	0	0	0	0	0	0	0	0	0	0
Scenedesmus,	pr.	7	8	0	5	7	6	3	2	0
Staurastrum,	30	33	3	2	4	1	2	0	0	0
Zoöspores,	0	27	0	0	0	0	0	0	0	0
Fungi. Crenothrix,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
ANIMALS.										
Rhizopoda. Difflugia,	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**
Infusoria,	**0**	**0**	**0**	**0**	**4**	**15**	**8**	**pr.**	**0**	**4**
Monas,	0	0	0	0	0	0	0	0	0	4
Peridinium,	0	0	0	0	0	0	0	pr.	0	0
Trachelomonas,	0	0	0	0	4	15	8	pr.	0	0
Vorticella,	0	0	0	0	0	0	0	0	0	0
Vermes,	**0**	**pr.**	**1**	**4**	**7**	**2**	**pr.**	**0**	**0**	**0**
Anurea,	0	0	0	0	4	1	pr.	0	0	0
Polyarthra,	0	pr.	0	0	0	0	0	0	0	0
Rotatorian ova,	0	0	0	0	3	1	0	0	0	0
Triarthra,	0	0	1	4	0	0	0	0	0	0
Crustacea,	**0**	**pr.**	**0**	**0**	**0**	**pr.**	**pr.**	**pr.**	**0**	**0**
Cyclops,	0	pr.	0	0	0	pr.	pr.	pr.	0	0
Daphnia,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	531	589	786	782	719	372	396	900	3,459	5,446

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	8	9	6	7	10	8	10	16	8	9
Number of sample,	5755	5855	5944	6031	6189	6373	6488	6589	6697	6795
PLANTS.										
Diatomaceæ,	**3,344**	**14,066**	**7,600**	**324**	**98**	**2,272**	**34**	**42**	**127**	**1,369**
Asterionella,	3,260	14,040	7,130	54	0	0	0	8	82	1,138
Cocconeis,	0	0	0	0	0	38	0	0	0	0
Fragillaria,	0	0	0	0	3	668	0	0	0	0
Melosira,	14	20	6	8	0	6	0	18	27	204
Navicula,	0	0	4	2	5	12	2	0	0	0
Nitzchia,	0	0	0	0	0	0	0	12	15	6
Stephanodiscus,	4	4	0	0	0	0	0	4	pr.	5
Synedra,	66	2	460	260	90	1,548	0	0	3	16
Tabellaria,	0	0	0	0	0	0	32	0	0	0
Cyanophyceæ,	**0**	**0**	**0**	**140**	**273**	**488**	**1,000**	**782**	**58**	**0**
Anabæna,	0	0	0	140	225	136	652	756	27	0
Clathrocystis,	0	0	0	0	10	144	6	0	0	0
Cœlosphærium,	0	0	0	0	20	208	342	26	31	0
Nostocaceous spores,	0	0	0	0	18	0	0	0	0	0
Algæ,	**2**	**0**	**34**	**304**	**709**	**1,002**	**44**	**92**	**83**	**228**
Chlorococcus,	0	0	0	142	325	356	8	76	7	6
Closterium,	0	0	0	92	0	0	0	0	0	pr.
Cœlastrum,	0	0	0	10	10	0	0	0	0	0
Cosmarium,	0	0	0	2	28	460	36	10	11	8
Pediastrum,	0	0	0	4	3	0	0	2	4	0
Polyedrium,	0	0	0	2	48	160	0	0	0	0
Raphidium,	0	0	0	4	0	0	0	0	12	0
Scenedesmus,	1	0	34	42	80	18	0	4	49	80
Staurastrum,	1	0	0	6	215	8	0	0	0	0
Zoöspores,	0	0	0	0	0	0	0	0	0	134
Fungi. Crenothrix,	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**22**	**3**
ANIMALS.										
Rhizopoda. Difflugia,	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**pr.**	**13**
Infusoria,	**0**	**1**	**0**	**12**	**21**	**18**	**4**	**4**	**pr.**	**0**
Monas,	0	1	0	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	0	0	2	4	0	0
Trachelomonas,	0	0	0	12	18	18	2	0	pr.	0
Vorticella,	0	0	0	0	3	0	0	0	0	0
Vermes,	**0**	**0**	**2**	**0**	**0**	**4**	**2**	**2**	**5**	**6**
Anurea,	0	0	2	0	0	2	2	2	3	3
Polyarthra,	0	0	0	0	0	2	0	0	0	1
Rotatorian ova,	0	0	0	0	0	0	0	0	2	2
Triarthra,	0	0	0	0	0	0	0	0	0	0
Crustacea,	**0**	**0**	**0**	**0**	**pr.**	**0**	**4**	**0**	**pr.**	**0**
Cyclops,	0	0	0	0	pr.	0	0	0	pr.	0
Daphnia,	0	0	0	0	pr.	0	4	0	pr.	0
TOTAL ORGANISMS,	3,347	14,069	7,636	780	1,101	3,784	1,088	922	295	1,619

WOBURN.

Chemical Examination of Water from the Distributing Reservoir of the Woburn Water Works.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
5609	Feb. 7	Feb. 8	Slight.	V. sl't.	0.00	–	–	.0000	.0050	.0022	.0028	1.94	.0330	.0001	–
5750	Mar. 5	Mar. 6	V. sl't.	None.	0.00	–	–	.0000	.0050	.0016	.0034	1.89	.0450	.0002	–

Odor, No. 5609, none; No. 5750, faintly vegetable and unpleasant. —— The samples were collected from the reservoir at the surface.

Microscopical Examination.

No. 5609. Diatomaceæ, *Asterionella*, 401. Algæ, *Closterium*, 1,454. *Gonium*, 139. Infusoria, *Monas*, 682. Vermes, *Diglena*, pr. Total organisms, 2,676.

No. 5750. Diatomaceæ, *Asterionella*, 8; *Stauroptera*, pr; *Synedra*, 5. Algæ, *Closterium*, *1,500. *Gonium*, 7. Infusoria, *Monas*, 69. Vermes, *Rotatorian ova*, pr. Total organisms, 1,589.

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* Estimated.

WATER SUPPLY OF WORCESTER.

LEICESTER SUPPLY. — *Chemical Examination of Water from the Lynde Brook Storage Reservoir.*

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4817	June 11	June 12	V. sl't.	V. sl't.	0.15	–	–	.0006	.0190	.0140	.0050	.20	.0030	.0001	–
4946	July 15	July 17	V. sl't.	V. sl't.	0.20	–	–	.0026	.0194	.0156	.0038	–	.0020	.0001	–
5049	Aug. 12	Aug. 13	V. sl't.	Slight.	0.10	–	–	.0000	.0180	.0156	.0024	–	.0030	.0000	–
5163	Sept. 10	Sept. 11	V. sl't.	V. sl't.	0.20	–	–	.0002	.0170	.0138	.0032	–	.0000	.0000	–
5239	Oct. 8	Oct. 10	Dist't.	Heavy.	0.30	–	–	.0074	.0200	.0154	.0046	–	.0050	.0000	–
5333	Nov. 11	Nov. 12	V. sl't.	V. sl't.	0.50	–	–	.0062	.0164	.0148	.0016	–	.0040	.0000	–
5426	Dec. 9	Dec. 10	V. sl't.	Slight.	0.25	–	–	.0052	.0152	.0124	.0028	–	.0070	.0001	–
	1890.														
5525	Jan. 13	Jan. 15	Slight.	Slight.	0.25	–	–	.0040	.0106	.0088	.0018	–	.0090	.0000	–
5616	Feb. 10	Feb. 11	V. sl't.	V. sl't.	0.35	–	–	.0014	.0116	.0084	.0032	–	.0100	.0000	–
5759	Mar. 10	Mar. 11	V. sl't.	V. sl't.	0.30	–	–	.0004	.0106	.0080	.0026	.15	.0150	.0002	–
5860	Apr. 8	Apr. 9	V. sl't.	V. sl't.	0.05	–	–	.0016	.0106	.0070	.0036	.10	.0060	.0001	–
5963	May 12	May 13	V. sl't.	V. sl't.	0.10	–	–	.0018	.0106	.0100	.0006	.16	.0070	.0001	–
6082	June 16	June 18	V. sl't.	V. sl't.	0.05	–	–	.0016	.0138	.0102	.0036	.14	.0040	.0001	–
6180	July 7	July 8	V. sl't.	V. sl't.	0.10	3.05	–	.0040	.0138	.0082	.0056	.13	.0030	.0000	0.9
6394	Aug. 12	Aug. 13	V. sl't.	Slight.	0.03	3.05	1.25	.0000	.0156	.0150	.0006	.16	.0080	.0001	1.1
6480	Sept. 8	Sept. 9	V. sl't.	V. sl't.	0.05	3.30	1.00	.0000	.0142	.0140	.0002	.16	.0080	.0001	0.9
6605	Oct. 15	Oct. 16	V. sl't.	V. sl't.	0.40	3.05	0.70	.0052	.0150	.0118	.0032	.11	.0060	.0001	0.9
6709	Nov. 10	Nov. 11	V. sl't.	Slight.	0.50	3.10	1.70	.0072	.0162	.0132	.0030	.16	.0050	.0001	0.9
6799	Dec. 8	Dec. 9	Slight.	Slight.	0.30	2.85	1.10	.0042	.0152	.0138	.0014	.13	.0120	.0000	0.9
Av.	....	....	....	....	0.22	3.07	1.15	.0028	.0149	.0121	.0028	.15	.0062	.0001	0.9

Odor, generally faintly vegetable, occasionally grassy, frequently none. —— The samples were collected from the reservoir, in front of the gate-house, one foot beneath the surface, with the exception of Nos. 5525, 5616, 5759, 5963, and 6709, which were collected at the foot of the overflow channel, below he dam.

WORCESTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	12	17	13	11	10	12	11	15	12	12
Number of sample,	4817	4946	5049	5163	5239	5333	5426	5525	5616	5759
PLANTS.										
Diatomaceæ,	**1**	**1**	**13**	**2**	**2**	**14**	**52**	**376**	**94**	**13**
Asterionella,	1	1	13	0	pr.	8	52	376	92	11
Melosira,	pr.	0	0	2	2	6	0	0	0	0
Stephanodiscus,	0	pr.	0	0	0	0	0	0	0	0
Synedra,	0	0	0	pr.	0	0	0	0	2	2
Tabellaria,	0	0	0	0	0	0	0	0	0	0
Cyanophyceæ,	**12**	**pr.**	**0**	**6**	**0**	**1**	**0**	**0**	**0**	**0**
Anabæna,	12	pr.	0	2	0	1	0	0	0	0
Aphanocapsa,	0	0	0	4	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Algæ,	**0**	**90**	**46**	**0**	**pr.**	**21**	**1**	**0**	**pr.**	**0**
Chlorococcus,	0	38	27	0	pr.	21	1	0	pr.	0
Raphidium,	0	52	19	0	0	0	0	0	0	0
Fungi. Crenothrix,	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ANIMALS.										
Rhizopoda,	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Actinophrys,	0	4	0	0	0	0	0	0	0	0
Arcella,	0	pr.	0	0	0	0	0	0	0	0
Infusoria,	**pr.**	**pr.**	**pr.**	**2**	**9**	**11**	**15**	**1**	**90**	**4**
Dinobryon,	pr.	0	0	0	8	6	12	1	90	4
Peridinium,	0	pr.	0	1	pr.	5	3	0	0	0
Trachelomonas,	0	0	pr.	1	1	0	0	0	0	0
TOTAL ORGANISMS,	28	95	59	10	11	47	68	377	184	17

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	13	18	9	14	9	17	12	10
Number of sample,	5860	5963	6082	6180	6394	6480	6605	6709	6799
PLANTS.									
Diatomaceæ,	**554**	**2**	**0**	**pr.**	**4**	**1**	**0**	**11**	**7**
Asterionella,	5	0	0	0	0	0	0	0	2
Melosira,	30	2	0	0	0	1	0	5	0
Stephanodiscus,	0	pr.	0	0	3	0	0	5	5
Synedra,	445	0	0	pr.	1	0	0	1	pr.
Tabellaria,	74	0	0	0	0	0	0	0	0
Cyanophyceæ,	**0**	**0**	**0**	**22**	**63**	**10**	**0**	**8**	**0**
Anabæna,	0	0	0	0	5	2	0	0	0
Aphanocapsa,	0	0	0	0	58	0	0	pr.	0
Chroöcoccus,	0	0	0	22	0	8	0	8	0
Algæ,	**2**	**pr.**	**3**	**43**	**10**	**0**	**0**	**0**	**0**
Chlorococcus,	2	pr.	3	38	10	0	0	0	0
Raphidium,	0	0	0	5	0	0	0	0	0
Fungi. Crenothrix,	**1**	**0**	**pr.**	**0**	**1**	**0**	**pr.**	**pr.**	**0**

WORCESTER.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.									
Rhizopoda,	pr.	0	0	0	0	8	0	0	0
Actinophrys,	pr.	0	0	0	0	0	0	0	0
Arcella,	0	0	0	0	0	8	0	0	0
Infusoria,	2	11	0	60	0	3	0	8	pr.
Dinobryon,	0	11	0	57	0	0	0	8	0
Peridinium,	2	0	0	3	0	3	0	0	pr.
Trachelomonas,	0	0	0	0	0	0	0	0	pr.
TOTAL ORGANISMS,	559	13	3	125	78	22	0	27	7

HOLDEN SUPPLY.

Chemical Examination of Water from Tatnuck Brook Storage Reservoir.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Suspended.		Nitrates.	Nitrites.	
	1889.														
4818	June 11	June 12	Dist't.	Slight.	0.20	–	–	.0004	.0156	.0138	.0018	.15	.0020	.0000	–
4947	July 16	July 17	Slight.	Slight.	0.20	–	–	.0002	.0194	.0144	.0050	–	.0000	.0001	–
5050	Aug. 12	Aug. 13	Slight.	Cons.	0.20	–	–	.0010	.0212	.0172	.0040	–	.0020	.0000	–
5162	Sept. 10	Sept. 11	Dist't.	Slight.	0.20	–	–	.0000	.0194	.0162	.0032	–	.0020	.0000	–
5240	Oct. 8	Oct. 10	Dist't.	He'vy.	0.25	–	–	.0000	.0176	.0122	.0054	–	.0040	.0000	–
5332	Nov. 11	Nov. 12	Slight.	Cons.	0.30	–	–	.0002	.0156	.0112	.0044	–	.0000	.0000	–
5427	Dec. 9	Dec. 10	V. sl't.	Slight.	0.20	–	–	.0002	.0124	.0108	.0016	–	.0020	.0001	–
	1890.														
5526	Jan. 13	Jan. 15	Slight.	Cous.	0.20	–	–	.0014	.0094	.0068	.0026	–	.0090	.0001	–
5617	Feb. 10	Feb. 11	V. sl't.	Slight.	0.20	–	–	.0000	.0066	.0048	.0018	–	.0100	.0000	–
5760	Mar. 10	Mar. 11	V. sl't.	Slight.	0.20	–	–	.0006	.0094	.0090	.0004	.12	.0110	.0001	–
5861	Apr. 8	Apr. 9	V. sl't.	Slight.	0.10	–	–	.0014	.0104	.0082	.0022	.16	.0090	.0000	–
5964	May 12	May 13	Slight.	Cons.	0.15	–	–	.0010	.0130	.0094	.0036	.12	.0030	.0000	–
6081	June 16	June 18	Dist't.	Slight.	0.05	–	–	.0002	.0120	.0094	.0026	.09	.0030	.0000	–
6181	July 7	July 8	Slight.	Slight.	0.10	2.35	–	.0014	.0132	.0098	.0034	.08	.0025	.0000	0.9
6393	Aug. 12	Aug. 13	Dist't.	Slight.	0.03	3.20	1.70	.0000	.0198	.0152	.0046	.14	.0080	.0001	1.1
6481	Sept. 8	Sept. 9	Dist't.	Cons.	0.25	2.90	1.25	.0002	.0250	.0156	.0094	.15	.0100	.0001	0.9
6606	Oct. 15	Oct. 16	Slight.	Cous.	0.30	2.70	1.10	.0000	.0198	.0114	.0084	.10	.0100	.0001	0.9
6710	Nov. 10	Nov. 11	V. sl't.	Slight.	0.35	2.40	1.40	.0010	.0136	.0088	.0048	.15	.0030	.0001	0.8
6798	Dec. 8	Dec. 9	V. sl't.	V. sl't.	0.10	2.50	0.75	.0006	.0168	.0144	.0024	.17	.0150	.0001	0.9
Av.	....	....	....	....	0.19	2.74	1.24	.0005	.0153	.0115	.0038	.13	.0056	.0000	0.9

Odor, generally faintly vegetable, or none; occasiously disagreeable.—The samples were collected from the reservoir, in front of the gate-house, from one to three feet beneath the surface, with the exception of Nos. 5427 to 5964, and Nos. 6181, 6606, and 6710, which were collected from the foot of the overflow channel, 200 feet below the dam.

WORCESTER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	12	17	13	11	10	12	11	15	12	12
Number of sample,	4818	4947	5050	5162	5240	5332	5427	5526	5617	5760
PLANTS.										
Diatomaceæ,	150	45	1,110	1,442	2,976	894	316	433	357	624
Asterionella,	50	3	350	598	1,883	62	35	84	106	93
Melosira,	25	10	8	2	83	35	6	7	4	0
Navicula,	0	0	0	0	0	0	0	0	0	0
Nitzchia,	0	0	0	0	0	0	0	0	0	0
Stephanodiscus,	0	0	pr.	0	0	0	0	0	0	0
Synedra,	25	0	0	2	0	1	5	14	21	153
Tabellaria,	50	32	752	840	1,010	796	270	328	226	378
Cyanophyceæ,	0	0	0	0	0	0	0	0	0	0
Aphanocapsa,	0	0	0	0	0	0	0	0	0	0
Chroöcoccus,	0	0	0	0	0	0	0	0	0	0
Algæ,	1	20	13	28	21	7	4	4	10	1
Chlorococcus,	1	16	12	21	8	4	4	3	0	1
Raphidium,	0	0	0	0	2	0	0	0	0	0
Scenedesmus,	0	pr.	0	0	0	1	0	1	0	0
Spirotænia,	0	0	0	0	0	0	0	0	10	0
Staurastrum,	pr.	4	1	7	11	2	0	0	0	pr.
Fungi. Leptothrix,	0	0	0	0	0	0	0	0	0	0
ANIMALS.										
Rhizopoda. Actinophrys,	0	0	0	0	0	0	0	0	0	0
Infusoria,	0	26	8	32	4	15	17	3	61	73
Dinobryon,	0	0	2	3	0	15	15	0	61	72
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	0	23	6	29	4	0	2	3	0	0
Trachelomonas,	0	3	0	0	pr.	0	0	0	0	1
Vermes. Anurea,	pr.	0	0	pr.	pr.	0	1	0	0	0
Crustacea. Cyclops,	0	pr.	0	pr.	0	0	0	0	0	0
TOTAL ORGANISMS,	151	91	1,131	1,502	3,001	916	338	440	428	698

WORCESTER.

Microscopical Examination. — Concluded.

[Number of organisms per cubic centimeter.]

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	13	18	9	13	9	17	12	10
Number of sample,	5861	5964	6081	6181	6393	6481	6606	6710	6798
PLANTS.									
Diatomaceæ,	**16**	**147**	**358**	**30**	**906**	**380**	**252**	**1,282**	**153**
Asterionella,	1	20	108	1	376	192	54	104	20
Melosira,	0	80	44	24	18	106	123	540	36
Navicula,	0	pr.	0	0	4	0	2	5	3
Nitzchia,	0	0	0	0	0	0	0	1	22
Stephanodiscus,	0	0	0	1	0	0	8	0	0
Synedra,	2	17	48	3	2	8	15	60	57
Tabellaria,	13	30	158	1	506	74	50	572	15
Cyanophyceæ,	**0**	**27**	**562**	**0**	**0**	**0**	**30**	**6**	**0**
Aphanocapsa,	0	27	498	0	0	0	0	0	0
Chroöcoccus,	0	0	64	0	0	0	30	6	0
Algæ,	**pr.**	**2**	**8**	**29**	**86**	**23**	**28**	**33**	**12**
Chlorococcus,	pr.	0	2	22	68	8	11	15	4
Raphidium,	0	0	0	0	12	0	6	4	4
Scenedesmus,	0	1	2	1	0	3	5	11	3
Spirotænia,	0	0	0	0	0	0	0	0	0
Staurastrum,	0	1	4	6	6	12	6	3	1
Fungi. Leptothrix,	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ANIMALS.									
Rhizopoda. Actinophrys,	**0**	**0**	**0**	**0**	**0**	**3**	**pr.**	**0**	**0**
Infusoria,	**7**	**16**	**76**	**0**	**46**	**87**	**1**	**4**	**8**
Dinobryon,	6	2	74	0	0	67	0	1	8
Monas,	0	pr.	0	0	0	3	0	0	0
Peridinium,	1	12	2	0	40	16	1	2	0
Trachelomonas,	0	2	0	0	6	1	pr.	1	0
Vermes. Anurea,	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**pr.**	**0**
Crustacea. Cyclops,	**0**	**0**	**0**	**0**	**pr.**	**3**	**0**	**0**	**0**
TOTAL ORGANISMS,	36	193	1,004	59	1,038	497	311	1,325	173

WORCESTER.

Record of Heights of Water in Holden and Leicester Storage Reservoirs at Times when Samples of Water were collected for Analysis.

NOTE.—Holden Reservoir, height of rollway, 20.10 feet; Leicester Reservoir, height of rollway, 37.40 feet.

DATE.	Height of Water.		DATE.	Height of Water.	
	Holden.	Leicester.		Holden.	Leicester.
1889.			**1890**—Con.		
June 11, ...	20.18	37.47	Mar. 10, ...	20.30	37.53
July 16, ...	18.86	35.98	Apr. 8, ...	20.35	37.60
Aug. 12, ...	20.14	37.37	May 12, ...	20.30	37.57
Sept. 10, ...	18.65	36.44	June 16, ...	20.20	37.50
Oct. 8, ...	20.25	37.10	July 7, ...	18.74	36.20
Nov. 11, ...	20.14	33.10	Aug. 12, ...	16.50	34.02
Dec. 9, ...	20.45	37.50	Sept. 8, ...	17.85	34.35
1890.			Oct. 15, ...	20.58	36.10
Jan. 13, ...	20.30	37.50	Nov. 10, ...	20.10	37.47
Feb. 10, ...	20.35	37.70			

EXAMINATIONS OF WATER SUPPLIES AND RIVERS.

RIVERS.

EXAMINATION OF RIVERS.

Blackstone River.

The sewage precipitation works of the city of Worcester, which were mentioned on page 386 of Part I. of the special report of the Board as being then under construction, were completed in the spring of 1890 and put in operation on June 25 of that year.

The principal portion of the sewage of the city of Worcester is discharged into the channel of Mill Brook, which flows into the Blackstone River at Quinsigamond Village, a short distance south of the thickly-settled portion of the city.

This brook receives the natural drainage from a water-shed of about 12.5 square miles, and as a square mile of water-shed in an ordinary year will furnish on an average about one million gallons of water daily, the average daily volume of brook water is in the neighborhood of 12,500,000 gallons. Quite a large portion of this water passes off during the spring freshets so that the average flow during the dryer months is much less than the amount above stated. At the present time the main sewer terminating at the new precipitation works, which are situated about one mile south of Quinsigamond Village and not far from the Blackstone River, extends only to the lower end of the Mill Brook channel where it intercepts the sewage of the city after being diluted with brook water.

In consequence of the large volume of mingled brook water and sewage it has not been feasible to treat the whole amount flowing in the brook, and it has been the practice during the time covered by this report to treat 3,000,000 gallons daily and permit the remainder to flow into the river untreated. Most of the untreated sewage enters the river, as formerly, at the mouth of Mill Brook but it has been a general rule to allow a little more than 3,000,000 gallons to flow to the precipitation works and to turn the excess into the river there through a by-pass.

At the precipitation works the sewage is treated with chemicals and then passed through settling tanks, and the clarified effluent is discharged into a ditch leading to the river. The sludge is disposed of at present on land a short distance from the precipitation works.

The system is still unfinished, the complete plan involving the separation of the sewage from the brook water, either by the construction of intercepting sewers on each side of the Mill Brook channel to intercept the flow from the lateral sewers into it, or by the construction of an independent channel or sewer to intercept the brook above where the sewers discharge into it and carry the water to the river, below the point where the brook is at present intercepted by the sewer leading to the precipitation works; in either case the sewers, during storms, will overflow into the river.

Chemical Examination of Water from the Blackstone River, below Quinsigamond Village, and above the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1889.														
4819	June 11	June 12	Dec'd	He'vy, e'rthy.	1.00	11.30	1.60	.2000	.1580	.1040	.0540	1.64	.0050	.0002	–
4945	July 16	July 17	Dec'd.	Very heavy.	0.10	–	–	.8800	.1620	.1350	.0270	–	.0300	.0030	–
5056	Aug. 13	Aug. 14	Dec'd.	He'vy.	0.20	–	–	.2520	.1100	.0440	.0660	1.05	.0200	.0027	–
5174	Sept. 11	Sept. 12	Dec'd.	Very heavy.	2.30	–	–	.5600	.2100	.0510	.1590	1.77	.0060	.0060	–
5245	Oct. 9	Oct. 10	Dist't.	He'vy.	0.05	–	–	.2480	.1200	.0480	.0720	1.01	.0200	.0015	–
5346	Nov. 12	Nov. 13	Dec'd.	Cons.	1.50	–	–	.2480	.0980	.0810	.0170	1.12	.0250	.0023	–
5432	Dec. 10	Dec. 11	Dec'd.	He'vy.	0.90	–	–	.1200	.0690	.0460	.0230	0.71	.0150	.0012	–
	1890.														
5527	Jan. 14	Jan. 15	Dec'd.	He'vy.	0.30	–	–	.1600	.0720	.0210	.0510	0.82	.0800	.0013	–
5651	Feb. 12	Feb. 13	Dec'd.	He'vy, e'rthy.	1.40	–	–	.1400	.0590	.0360	.0230	0.56	.0500	.0013	–
5777	Mar. 11	Mar. 12	Dec'd.	He'vy.	0.30	–	–	.1640	.0790	.0410	.0380	1.10	.0400	.0006	–
5865	Apr. 9	Apr. 10	Dec'd.	He'vy.	0.15	–	–	.0840	.0560	.0280	.0280	0.68	.0400	.0012	–
5965	May 12	May 13	Dec'd.	He'vy.	0.00	–	–	.1800	.0900	.0390	.0510	1.92	.0250	.0019	–
6084	June 16	June 18	Dec'd.	He'vy.	1.00	–	–	.2600	.1510	.0600	.0910	1.44	.0150	.0001	–
6182	July 7	July 8	Dec'd.	He'vy.	1.30	9.60	–	.2240	.1280	.0680	.0600	1.18	.0050	.0000	2.86
6391	Aug. 11	Aug. 13	Dec'd, op'q'e.	Very heavy.	1.10	10.20	3.60	.1800	.1650	.0940	.0710	1.05	.0100	.0001	2.99
6482	Sept. 8	Sept. 9	Dec'd.	Very heavy.	1.20	10.90	3.20	.2200	.0690	.0350	.0340	0.93	.0450	.0026	2.99
6586	Oct. 13	Oct. 14	Dec'd	He'vy.	0.85	9.50	2.70	.2000	.1330	.0750	.0580	1.01	.0500	.0023	2.47
6704	Nov. 10	Nov. 11	Dec'd.	He'vy.	1.40	9.40	2.60	.1800	.1020	.0720	.0300	0.84	.0250	.0037	2.99
6796	Dec. 8	Dec. 9	Dec'd.	He'vy.	0.90	10.20	3.10	.1680	.1250	.0900	.0350	0.89	.0550	.0022	2.60
Av.	....	....	....	....	0.84	9.97	3.04	.2452	.1135	.0615	.0520	1.10	.0295	.0018	2.82

Odor, offensive. —— The samples were collected from the river about 200 feet below the iron bridge, which is the first bridge below the Quinsigamond Iron and Wire Works. This point is above the place where the effluent from the Worcester Sewage Precipitation Works enters the river. Previous to May, 1890, the samples were collected on Tuesday, with the exception of Nos. 5174, 5245, 5651 and 5865, which were collected on Wednesday. All samples since May 1, 1890, have been collected on Monday. Samples numbered 4819, 5527, 5865, 6182, 6391, 6586, 6704 and 6796 were collected between 2.45 and 3.45 P.M. No. 5174 was collected at 12 M. The time of collection of 6084 is not given. All other samples were collected between 9.45 and 11.15 A.M.

BLACKSTONE RIVER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	12	17	14	12	12	14	17	15	15	14
Number of sample,	4819	4945	5056	5174	5245	5346	5432	5527	5651	5777
PLANTS.										
Diatomaceæ. Tabellaria,	pr.	0	0	0	0	0	0	0	0	–
Algæ. Bulbochæte,	0	0	49	50	0	0	0	0	0	–
Fungi,	0	0	0	0	0	0	0	0	0	–
Beggiatoa,	0	0	0	0	0	0	0	0	0	–
Cladothrix,	0	0	0	0	0	0	0	0	0	–
ANIMALS.										
Infusoria,	0	pr.	0	8	0	1	0	5	0	–
Ciliated infusorian,	0	0	0	5	0	0	0	0	0	–
Peridinium,	0	0	0	0	0	1	0	5	0	–
Trachelomonas,	0	pr.	0	3	0	0	0	0	0	–
TOTAL ORGANISMS,	pr.	pr.	49	58	0	1	0	5	0	–

	1890.								
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	14	18	9	13	9	14	11	10
Number of sample,	5865	5965	6084	6182	6391	6482	6586	6704	6796
PLANTS.									
Diatomaceæ. Tabellaria,	0	0	0	0	0	0	0	11	0
Algæ. Bulbochæte,	0	0	0	0	0	0	0	0	0
Fungi,	0	0	0	0	30	0	70	224	96
Beggiatoa,	0	0	0	0	0	0	0	0	96
Cladothrix,	0	0	0	0	30	0	70	224	0
ANIMALS.									
Infusoria,	0	0	0	0	0	0	0	0	0
Ciliated infusorian,	0	0	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	0	0	0	0	30	0	70	224	96

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River, below the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Hardness.
	1890.														
6321	July 30	July 31	Dec'd.	Heavy.	0.90	13.10	3.30	.4320	.1980	.0880	.1100	2.18	.0100	.0001	–
6392	Aug. 11	Aug. 13	Dec'd, op'q'e.	Very heavy.	0.80	12.80	4.10	.3400	.1720	.0800	.0920	1.90	.0100	.0001	3.77
6483	Sept. 8	Sept. 9	Dec'd.	Heavy.	1.00	10.60	2.80	.2320	.0730	.0330	.0400	0.98	.0450	.0038	2.99
6585	Oct. 13	Oct. 14	Dec'd.	Heavy.	0.70	10.00	2.60	.2600	.1630	.0910	.0720	1.26	.0500	.0025	2.86
6705	Nov. 10	Nov. 11	Dec'd.	Heavy.	1.40	10.30	2.70	.2200	.1380	.0810	.0570	1.03	.0320	.0040	3.25
6797	Dec. 8	Dec. 9	Dec'd.	Heavy.	0.90	11.80	3.70	.2320	.1620	.0990	.0630	1.28	.0600	.0026	2.73
Av.	....	....	....	....	0.95	11.43	3.20	.2860	.1510	.0787	.0723	1.44	.0345	.0022	3.72

Odor, offensive.—— The samples were collected from the river above Millbury and below the point where the effluent from the Sewage Precipitation Works of the city of Worcester enters the river. The samples were collected between 2.45 and 3.45 P.M., with the exception of No. 6483, which was collected at 10.45 A.M. Sample No. 6321 was collected on Wednesday; the others on Monday.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.					
	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination, ...	2	13	9	14	11	10
Number of sample, ...	6321	6392	6483	6585	6705	6797
PLANTS.						
Diatomaceæ, ...	**0**	**0**	**4**	**0**	**11**	**0**
Asterionella, ...	0	0	0	0	4	0
Nitzchia, ...	0	0	0	0	3	0
Synedra, ...	0	0	4	0	4	0
Cyanophyceæ. Oscillaria, . .	**0**	**5**	**0**	**0**	**0**	**0**
Fungi. Cladothrix, ...	**0**	**10**	**0**	**138**	**268**	**0**
ANIMALS.						
Infusoria. Dinobryon, ...	**0**	**0**	**0**	**0**	**1**	**0**
TOTAL ORGANISMS, ...	0	15	4	138	280	0

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River, at Uxbridge.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	1889.														
4829	June 13	June 13	Dist't.	Cons.	0.20	6.00	1.20	.1040	.0410	.0068	.0342	.54	.0250	.0014	–
4948	July 17	July 17	Slight.	Slight.	0.50	–	–	.1360	.0330	.0340	.0010	–	.0450	.0008	–
5059	Aug. 14	Aug. 14	Dist't.	Cons.	0.45	–	–	.0520	.0290	.0210	.0080	.66	.0220	.0017	–
5161	Sept. 11	Sept. 11	Slight.	Slight.	0.30	–	–	.1000	.0210	–	–	.81	.0680	.0004	–
5236	Oct. 9	Oct. 9	V. sl't.	Slight.	0.20	–	–	.1480	.0320	.0250	.0070	.67	.0180	.0005	–
5345	Nov. 11	Nov. 13	Dec'd.	Slight.	0.30	–	–	.1400	.0130	.0100	.0030	.62	.0220	.0007	–
5433	Dec. 11	Dec. 11	Dec'd.	Slight.	0.25	–	–	.0640	.0360	.0230	.0130	.63	.0300	.0007	–
	1890.														
5533	Jan. 15	Jan. 16	Dist't.	Slight.	0.00	–	–	.0880	.0100	.0060	.0040	.51	.0350	.0007	–
5633	Feb. 12	Feb. 12	Dec'd.	Cons.	0.50	–	–	.0600	.0230	.0130	.0100	.40	.0300	.0004	–
5778	Mar. 12	Mar. 13	Dist't.	–	0.00	–	–	.0720	.0130	.0080	.0050	.47	.0180	.0008	–
5900	Apr. 16	Apr. 17	Slight.	Cons.	0.30	–	–	.0600	.0350	.0220	.0130	.47	.0250	.0009	–
5966	May 13	May 13	Dec'd.	Cons.	0.20	–	–	.0760	.0260	.0200	.0060	.42	.0200	.0007	–
6078	June 17	June 18	Dist't.	Cons. rusty.	0.10	–	–	.1400	.0230	.0180	.0050	.49	.0300	.0007	–
6188	July 8	July 9	Slight.	Slight, rusty.	0.15	9.20	–	.2200	.0210	.0210	.0000	.62	.0120	.0002	2.21
6314	July 30	July 30	Slight.	Cons.	0.10	8.70	1.70	.1920	.0260	.0170	.0090	.84	.0040	.0002	3.38
6396	Aug. 13	Aug. 14	Slight.	Cons., rusty.	0.30	10.10	3.00	.2320	.0250	.0210	.0040	.97	.0080	.0004	3.51
6485	Sept. 9	Sept. 9	Dist't.	Cons.	0.20	9.25	2.00	.1680	.0200	.0140	.0060	.88	.0400	.0005	3.12
6584	Oct. 14	Oct. 14	Dist't.	Heavy, rusty.	0.50	8.20	2.30	.1320	.0280	.0240	.0040	.65	.0650	.0006	2.47
6708	Nov. 11	Nov. 11	Dist't.	Cons.	0.45	7.70	1.60	.0560	.0190	.0070	.0120	1.06	.0220	.0012	2.99
6801	Dec. 9	Dec. 11	Dec'd.	Slight.	0.40	7.00	1.25	.0224	.0094	.0064	.0030	0.74	.0450	.0010	2.47
Av.	....	....	....	....	0.27	8.27	1.69	.1131	.0242	.0167	.0077	0.67	.0302	.0007	2.88

Odor, musty and disagreeable, frequently offensive. —— The samples were collected from the canal from the upper dam of the Calumet Woolen Company, just before the water passes the screens to the wheels.

BLACKSTONE RIVER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	13	17	14	11	10	13	-	16	14	15
Number of sample,	4829	4948	5059	5161	5236	5345	5433	5533	5633	5778
PLANTS.										
Diatomaceæ,	4	2	13	9	5	1	-	0	2	0
Asterionella,	0	0	6	0	0	0	-	0	2	0
Synedra,	2	0	5	4	pr.	1	-	0	0	0
Tabellaria,	2	2	2	5	5	0	-	0	0	0
Algæ. Chlorococcus,	4	10	0	2	6	0	-	0	0	0
ANIMALS.										
Infusoria,	1	23	1	103	16	0	-	pr.	0	0
Dinobryon,	1	21	0	101	16	0	-	pr.	0	0
Peridinium,	pr.	2	1	2	0	0	-	0	0	0
Trachelomonas,	0	0	0	pr.	0	0	-	0	0	0
Vermes. Polyarthra,	0	0	0	2	0	0	-	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	-	0	0	0
TOTAL ORGANISMS,	9	35	14	116	27	1	-	0	2	0

	1890.									
	April.	May.	June.	July.	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	14	18	10	2	14	9	14	12	10
Number of sample,	5900	5966	6078	6188	6314	6396	6485	6584	6708	6801
PLANTS.										
Diatomaceæ,	26	16	0	5	1	0	25	4	13	3
Asterionella,	23	16	0	0	0	0	0	0	3	2
Synedra,	3	0	0	1	0	0	0	0	6	1
Tabellaria,	0	0	0	4	1	0	25	4	4	0
Algæ. Chlorococcus,	0	0	0	0	0	0	0	0	0	0
ANIMALS.										
Infusoria,	9	36	0	0	0	0	50	0	3	0
Dinobryon,	9	34	0	0	0	0	49	0	3	0
Peridinium,	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	2	0	0	0	0	1	0	0	0
Vermes. Polyarthra,	0	0	0	0	0	0	1	0	0	0
Porifera Sponge spicules,	0	0	0	0	0	0	0	2	0	0
TOTAL ORGANISMS,	35	52	0	5	1	0	76	6	16	3

BLACKSTONE RIVER.

Chemical Examination of Water from the Blackstone River at Millville, Blackstone.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1889.														
4830	June 13	June 14	Dec'd.	Cons.	0.20	4.70	1.20	.0560	.0630	.0440	.0190	.36	.0150	.0000	–
4959	July 19	July 20	Dist't.	Slight.	0.50	–	–	.0510	.0200	.0180	.0020	.44	.0050	.0005	–
5064	Aug. 15	Aug. 15	Slight.	Slight.	0.60	–	–	.0224	.0216	.0196	.0020	.38	.0200	.0005	–
5175	Sept. 12	Sept. 13	Slight.	Slight.	0.40	–	–	.0320	.0240	.0190	.0050	.51	.0250	.0003	–
5241	Oct. 9	Oct. 10	Slight.	Slight.	0.30	–	–	.0960	.0170	.0150	.0020	.55	.0220	.0002	–
5350	Nov. 14	Nov. 15	Dist't.	Slight.	0.30	–	–	.0424	.0180	.0122	.0058	.47	.0130	.0003	–
5440	Dec. 13	Dec. 13	Slight.	Slight.	0.90	–	–	.0256	.0248	.0220	.0028	.39	.0200	.0002	–
	1890.														
5546	Jan. 17	Jan. 18	Dist't.	V. sl't.	0.55	–	–	.0560	.0292	.0244	.0048	.49	.0300	.0005	–
5681	Feb. 15	Feb. 17	Dec'd.	He'vy.	0.20	–	–	.0342	.0172	.0084	.0088	.37	.0250	.0003	–
5787	Mar. 14	Mar. 14	Slight.	Slight.	0.30	–	–	.0232	.0180	.0136	.0044	.36	.0250	.0005	–
5878	Apr. 11	Apr. 12	Slight.	Cons.	0.40	–	–	.0232	.0174	.0140	.0034	.28	.0250	.0003	–
5989	May 16	May 17	Dist't.	Slight.	0.40	–	–	.0456	.0262	.0184	.0078	.35	.0120	.0004	–
6103	June 19	June 20	Slight.	Slight.	0.25	–	–	.0480	.0198	.0176	.0022	.39	.0250	.0003	1.10
6206	July 11	July 12	Slight.	Slight.	0.20	5.50	–	.1096	.0178	.0138	.0040	.43	.0125	.0001	2.08
6333	Aug. 1	Aug. 2	Slight.	Cons.	0.05	7.05	2.70	.1384	.0222	.0186	.0036	.60	.0080	.0003	2.21
6414	Aug. 16	Aug. 18	Dist't.	Cons.	0.30	8.50	2.90	.0376	.0054	.0044	.0010	.73	.0250	.0001	3.64
6495	Sept. 10	Sept. 11	Slight.	Cons.	0.20	7.55	2.75	.0800	.0268	.0206	.0062	.60	.0400	.0005	2.08
6613	Oct. 16	Oct. 17	Slight.	Cons.	0.40	5.80	1.45	.0504	.0236	.0170	.0066	.47	.0200	.0005	2.34
6716	Nov. 11	Nov. 12	Slight.	Slight.	0.45	5.85	1.40	.0512	.0216	.0144	.0072	.50	.0300	.0005	2.47
6803	Dec. 10	Dec. 11	Slight.	Slight.	0.70	6.10	2.65	.0658	.0288	.0256	.0032	.45	.0350	.0007	2.08
Av.	....	....	....	....	0.38	6.81	2.31	.0544	.0231	.0180	.0051	.46	.0216	.0003	2.25

Odor, generally musty and disagreeable. —— The samples were collected from the river at the bridge, just above the dam, in the village of Millville. Heavy rains occurred just previous to the collection of samples numbered 5064, 5175, 5440, 5681, 5787, 5878, 6495.

BLACKSTONE RIVER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1889.							1890.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Day of examination,	14	20	15	13	10	16	14	22	18	15
Number of sample,	4830	4959	5064	5175	5241	5350	5440	5546	5681	5787
PLANTS.										
Diatomaceæ,	6	23	3	0	7	2	2	10	2	0
Asterionella,	0	8	0	0	2	2	2	10	0	0
Ceratoneis,	0	0	0	0	0	0	0	0	0	0
Synedra,	6	6	3	0	2	0	pr.	0	0	0
Tabellaria,	pr.	9	0	0	3	0	0	0	2	0
Cyanophyceæ. Anabæna,	0	0	0	0	0	0	0	0	0	0
Algæ. Chlorococcus,	1	3	0	9	pr.	0	0	0	0	0
Fungi. Crenothrix,	4	36	7	104	7	250	0	0	0	0
ANIMALS.										
Infusoria,	pr.	108	pr.	22	pr.	0	pr.	0	0	0
Dinobryon,	pr.	108	0	22	pr.	0	0	0	0	0
Monas,	0	0	0	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	pr.	0	pr.	0	0	0
Trachelomonas,	0	0	pr.	0	0	0	0	0	0	0
Porifera. Sponge spicules,	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS,	11	170	10	135	14	252	2	10	2	0

	1890.									
	April.	May.	June.	July.	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	15	20	27	12	2	19	11	18	13	12
Number of sample,	5878	5989	6103	6206	6333	6414	6495	6613	6716	6803
PLANTS.										
Diatomaceæ,	0	25	2	31	1	34	20	2	8	7
Asterionella,	0	10	0	0	0	0	0	0	2	2
Ceratoneis,	0	0	2	8	0	0	0	0	0	0
Synedra,	0	15	0	10	0	18	10	2	6	5
Tabellaria,	0	0	0	13	1	16	10	0	pr.	0
Cyanophyceæ. Anabæna,	0	0	0	0	0	18	2	0	0	0
Algæ. Chlorococcus,	0	1	0	16	5	40	0	0	0	0
Fungi. Crenothrix,	1	2	16	pr.	191	40	22	22	0	0

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.									
	April.	May.	June.	July.	Aug.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.										
Infusoria,	**0**	**9**	**0**	**76**	**6**	**8**	**49**	**0**	**3**	**pr.**
Dinobryon,	0	8	0	71	0	6	48	0	3	pr.
Monas,	0	0	0	3	0	0	0	0	0	0
Peridinium,	0	0	0	2	0	2	0	0	0	0
Trachelomonas,	0	1	0	pr.	6	0	1	0	0	0
Porifera. Sponge spicules,	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**
TOTAL ORGANISMS,	1	37	18	123	203	140	93	24	16	7

CHARLES RIVER.

NOTE.—For analyses of the water of this river at Newton, Waltham and Watertown, see pages 214, 261 and 264.

Chemical Examination of Water from the Charles River, at Milford.

[Parts per 100,000.]

	Date of		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6266	July 21	July 22	V. sl't.	Slight.	0.35	11.60	–	.1570	.0448	.0372	.0076	2.94	.0020	.0007	–
6303	July 28	July 29	V. sl't.	Slight.	0.40	10.20	2.80	.1320	.0450	.0330	.0120	1.32	.0350	.0177	3.12

Odor, vegetable and mouldy.—The samples were collected from the river at the first railroad bridge below Milford, about one mile below the main portion of the town.

Microscopical Examination.

No. 6266. Diatomaceæ, *Synedra*, 1; *Tabellaria*, pr. Algæ, *Chlorococcus*, 2. Fungi, *Crenothrix*, 73. Infusoria, *Peridinium*, pr. Total organisms, 76.

No. 6303. Diatomaceæ, *Cocconeis*, pr.; *Navicula*, 1; *Synedra*, pr. Cyanophyceæ, *Chroöcoccus*, 9. Algæ, *Chlorococcus*, pr.; *Zygogonium*, pr.; *Cœlastrum*, pr.; *Characium*, pr. Fungi, *Crenothrix*, 57. Infusoria, *Vorticella*, pr. Total organisms, 67.

CHARLES RIVER.

Chemical Examination of Water from the Charles River, at South Natick.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	18	90.													
6263	July 19	July 21	V. sl't.	None.	0.40	3.85	–	.0006	.0226	.0220	.0006	.36	.0020	.0003	1.83
6293	July 28	July 28	Slight.	Slight.	0.30	4.00	1.55	.0016	.0288	.0250	.0038	.35	.0020	.0003	1.95

Odor, vegetable. —— The samples were collected from the river just above the dam at South Natick.

Microscopical Examination.

No. 6263. Diatomaceæ, *Ceratoneis*, 2; *Melosira*, pr.; *Nitzchia*, pr.; *Synedra*, 1; *Tabellaria*, pr. Algæ, *Chlorococcus*, 13; *Cœlastrum*, 1; *Raphidium*, 2; *Scenedesmus*, pr.; *Staurogenia*, pr. Fungi, *Crenothrix*, 20. Infusoria, *Peridinium*, 12. Total organisms, 51.

No. 6293. Diatomaceæ, *Synedra*, 2. Algæ, *Chlorococcus*, 10; *Cœlastrum*, 1; *Conferva*, pr.; *Cosmarium*, pr. Fungi, *Crenothrix*, 29. Infusoria, *Dinobryon*, 2; *Euglena*, pr.; *Peridinium*, 1; *Synura*, 23; *Trachelomonas*, pr. Total organisms, 68.

CHICOPEE RIVER.

Analyses of water from the Chicopee River, at Chicopee Falls, may be found on pages 128 and 129.

CONNECTICUT RIVER.

Chemical Examination of Water from the Connecticut River, above Turner's Falls, in Montague.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
									Total.	Dissolved.	Suspended.				
	18	89.													
4838	June 14	June 15	Dist't.	Cons.	0.40	4.80	1.60	.0024	.0156	.0130	.0026	–	.0050	.0001	–

Odor, none. —— The sample was collected from the river above the bridge at Turner's Falls.

Microscopical Examination.

Diatomaceæ, *Ceratoneis*, 1; *Melosira*, 2; *Synedra*, 10; *Tabellaria*, 3. Total organisms, 16.

Hoosac River.

Chemical Examination of Water from the Hoosac River, at Williamstown.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	18	90.													
6277	July 22	July 23	Slight.	Cons., earthy.	0.10	14.15	–	.0216	.0276	.0174	.0102	.37	.0250	.0010	11.65
6362	Aug. 5	Aug. 6	Dist't.	Cons., e'thy & floc't.	0.15	14.85	2.65	.0294	.0270	.0214	.0056	.35	.0400	.0021	13.16
6442	Aug. 26	Aug. 27	Dist't.	Slight, earthy.	0.30	12.30	2.20	.0028	.0298	.0200	.0098	.23	.0200	.0045	9.20
Av.	....	....	....	....	0.18	13.77	2.42	.0179	.0281	.0196	.0085	.35	.0283	.0025	11.34

Odor, vegetable and musty.—— The samples were collected from the river, at the bridge near the Williamstown Station on the Fitchburg Railroad.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	July.	Aug.	Aug.
Day of examination,	23	2	27
Number of sample,	6277	6362	6442
PLANTS.			
Diatomaceæ,	**19**	**9**	**2**
Ceratoneis,	0	2	0
Navicula,	11	pr.	2
Synedra,	8	7	0
Algæ,	**6**	**6**	**2**
Chlorococcus,	6	4	0
Closterium,	0	2	0
Cosmarium,	0	0	2
Fungi. Crenothrix,	**0**	**2**	**0**
ANIMALS.			
Infusoria,	**0**	**1**	**0**
Euglena,	0	pr.	0
Monas,	0	pr.	0
Peridinium,	0	pr.	0
Trachelomonas,	0	pr.	0
Vorticella,	0	1	0
TOTAL ORGANISMS,	25	18	4

HOUSATONIC RIVER.

Chemical Examination of Water from the West Branch of the Housatonic River, below Pittsfield.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6824	July 23	July 24	Dec'd.	He'vy, e'rthy, floc't.	0.50	14.05	-	.0018	.0666	.0374	.0292	.23	.0020	.0005	8.3
6476	Sept. 4	Sept. 8	Dec'd.	Cons.	0.35	16.05	-	.0094	.0466	.0264	.0202	.33	.0950	.0180	10.4

Odor, vegetable and disagreeable. —— The samples were collected from the river, near the South Street bridge, a short distance above the confluence of the east and west branches.

Microscopical Examination.

No. 6284. Infusoria, *Peridinium*, 2. No. 6476. Diatomaceæ, *Synedra*, 6. Algæ, *Sorastrum*, 2. Infusoria, *Monas*, 2; *Trachelomonas*, 2. Total organisms, 12.

Chemical Examination of Water from the Housatonic River, below the Confluence of the East and West Branches.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6328	July 31	Aug. 1	V. sl't.	Cons., earthy.	0.30	12.15	1.80	.0132	.0220	.0184	.0036	.26	.0070	.0006	9.3

Odor, vegetable and musty. —— The sample was collected from the river, at the first bridge below the confluence of the east and west branches.

Microscopical Examination.

Diatomaceæ, *Synedra*, 3. Cyanophyceæ, *Oscillaria*, pr. Algæ, *Closterium*, pr.; *Scenedesmus*, pr. Fungi, *Crenothrix*, 148. Infusoria, *Trachelomonas*, pr. Total organisms, 151.

HOUSATONIC RIVER.

Chemical Examination of Water from the Housatonic River, at Great Barrington.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6289	July 24	July 25	Slight.	Slight.	0.05	13.25	-	.0034	.0210	.0148	.0062	.25	.0050	.0003	10.52
6320	July 30	July 31	V. sl't.	Cons.	0.10	13.05	-	.0022	.0178	.0140	.0038	.22	.0150	.0004	10.15
6443	Aug. 25	Aug. 27	V. sl't.	V. sl't.	0.35	11.55	2.70	.0046	.0206	.0176	.0030	.20	.0160	.0003	9.51
Av.	....	....	....	....	0.17	12.62	-	.0034	.0198	.0155	.0043	.22	.0120	.0003	10.06

Odor, vegetable. —— The samples were collected from the Housatonic River, at the Leavitt Street bridge, below the village.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.		
	July.	Aug.	Aug.
Day of examination,	25	2	27
Number of sample,	6289	6320	6443
PLANTS.			
Diatomaceæ,	**36**	**51**	**2**
Navicula,	2	2	1
Synedra,	34	49	1
Cyanophyceæ. Chroöcoccus,	**0**	**0**	**2**
Algæ,	**16**	**50**	**0**
Chlorococcus,	16	26	0
Cœlastrum,	pr.	2	0
Raphidium,	0	21	0
Spirogyra,	pr.	1	0
Fungi. Crenothrix,	**3**	**0**	**13**
ANIMALS.			
Infusoria. Peridinium,	**2**	**3**	**0**
TOTAL ORGANISMS,	57	104	17

MERRIMACK RIVER.

Analyses of the Merrimack River at Lowell are given on pages 179–181, and at Lawrence on pages 163 and 164. The volumes of water flowing in the river at the times when samples were collected for analyses are given on page 174.

NASHUA RIVER.

Chemical Examination of Water from the North Branch of the Nashua River, just above its Confluence with the South Branch, at Lancaster.

[Parts per 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.
	1890.														
6287	July 24	July 25	Dist't.	Cons.	0.30	8.70	–	.0192	.0334	.0290	.0044	.86	.0150	.0008	3.0
6334	Aug. 1	Aug. 2	Dec'd.	Cons.	0.40	7.15	2.10	.0120	.0332	.0282	.0050	.57	.0120	.0016	2.6
6358	Aug. 4	Aug. 5	Slight.	Slight.	0.30	6.70	2.20	.0076	.0326	.0274	.0052	.59	.0300	.0011	2.3
6369	Aug. 5	Aug. 6	Very slight.	Slight.	0.40	6.60	2.10	.0118	.0322	.0262	.0060	.58	.0250	.0016	2.7
6375	Aug. 6	Aug. 7	Slight.	Slight.	0.50	6.65	2.10	.0078	.0318	.0264	.0054	.51	.0250	.0017	2.2
Av.	....	....	....	....	0.38	6.77	2.12	.0117	.0326	.0274	.0052	.62	.0214	.0014	2.6

Odor, vegetable.—The samples were collected from the north branch at the railroad bridge, about a third of a mile above the confluence of the north and south branches.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890. July.	1890. Aug.	1890. Aug.	1890. Aug.	1890. Aug.
Day of examination, ...	25	5	6	6	6
Number of sample, ...	6287	6334	6358	6369	6375
PLANTS.					
Diatomaceæ, ...	**43**	**23**	**38**	**37**	**33**
Asterionella, ...	15	2	12	6	6
Melosira, ...	9	0	0	0	6
Navicula, ...	12	5	2	10	2
Synedra, ...	7	16	24	21	19
Cyanophyceæ. Oscillaria, . .	**0**	**pr.**	**4**	**0**	**0**

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.				
	July.	Aug.	Aug.	Aug.	Aug.
PLANTS — Con.					
Algæ, ...	**102**	**26**	**154**	**85**	**90**
Chlorococcus, ...	54	22	130	79	79
Cœlastrum, ...	6	pr.	2	0	0
Pediastrum, ...	2	pr.	0	0	1
Raphidium, ...	31	0	12	4	4
Scenedesmus, ...	6	3	2	2	2
Staurastrum, ...	3	1	4	0	3
Staurogenia, ...	0	0	4	0	1
Fungi. Crenothrix, ...	**2**	**0**	**2**	**0**	**2**
ANIMALS.					
Infusoria, ...	**12**	**4**	**10**	**16**	**6**
Dinobryon, ...	4	0	0	0	0
Peridinium, ...	7	2	6	11	2
Trachelomonas, ...	1	2	4	5	4
TOTAL ORGANISMS, ...	159	53	208	138	131

Chemical Examination of Water from the South Branch of the Nashua River, just above its Confluence with the North Branch, at Lancaster.

[Parts per 100,000.]

Number.	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6288	July 24	July 25	Dist't.	Cons.	0.20	5.45	-	.0192	.0270	.0220	.0050	.29	.0025	.0005	1.6
6335	Aug. 1	Aug. 2	Dist't.	Cons.	0.20	4.35	1.95	.0128	.0294	.0202	.0092	.22	.0120	.0001	1.4
6368	Aug. 5	Aug. 6	V. sl't.	Cons.	0.40	4.55	1.60	.0138	.0294	.0198	.0096	.34	.0150	.0003	1.8
6376	Aug. 6	Aug. 7	Slight.	Cons.	0.40	5.15	2.00	.0190	.0294	.0232	.0062	.39	.0120	.0004	1.9
Av.	....	....	....	....	0.30	4.68	1.85	.0162	.0288	.0213	.0075	.31	.0104	.0003	1.7

Odor, vegetable and musty.——The samples were collected from the south branch, at the Atherton bridge.

NASHUA RIVER.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.			
	July.	Aug.	Aug.	Aug.
Day of examination,	25	5	6	9
Number of sample,	6288	6335	6368	6376
PLANTS.				
Diatomaceæ,	**27**	**218**	**26**	**36**
Asterionella,	4	138	15	23
Cyclotella,	0	4	0	0
Melosira,	5	32	0	0
Navicula,	5	13	2	2
Pinnularia,	1	pr.	pr.	2
Synedra,	12	28	9	9
Tabellaria,	0	3	0	pr.
Cyanophyceæ,	**0**	**8**	**0**	**7**
Aphanocapsa,	0	0	0	7
Chroöcoccus,	0	8	0	0
Algæ,	**37**	**88**	**13**	**42**
Chlorococcus,	35	76	10	38
Cœlastrum,	1	5	2	0
Pediastrum,	1	2	0	2
Scenedesmus,	0	5	1	2
Fungi. Crenothrix,	**4**	**73**	**3**	**32**
ANIMALS.				
Rhizopoda. Actinophrys,	**0**	**pr.**	**0**	**pr.**
Infusoria,	**6**	**1**	**pr.**	**1**
Dinobryon,	1	0	0	0
Peridinium,	4	pr.	pr.	pr.
Trachelomonas,	0	1	pr.	1
Vorticella,	1	0	0	0
TOTAL ORGANISMS,	74	388	42	118

NEPONSET RIVER.

Chemical Examination of Water from the Neponset River, at Milton Lower Mills.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6273	July 22	July 22	Dist't.	Slight.	0.95	10.50	–	.0612	.1242	.1218	.0024	1.02	.0030	.0012	3.51
6294	July 28	July 28	Dist't.	Cons.	0.60	8.25	2.35	.0136	.0602	.0308	.0294	1.15	.0025	.0007	2.86
6337	Aug. 4	Aug. 4	Slight.	Cons.	0.60	7.65	2.20	.0092	.0398	.0296	.0102	1.12	.0075	.0008	2.86
6437	Aug. 26	Aug. 26	Slight.	Cons.	0.60	8.75	2.75	.0168	.0484	.0390	.0094	1.29	.0150	.0009	3.90
Av.	....	....	....	....	0.69	8.79	2.43	.0252	.0681	.0553	.0128	1.04	.0070	.0009	3.28

Odor, generally musty and disagreeable. —— The samples were collected from the river, at Milton Lower Mills.

Microscopical Examination.

[Number of organisms per cubic centimeter.]

	1890.			
	July.	July.	Aug.	Aug.
Day of examination,	23	29	5	26
Number of sample,	6273	6294	6337	6437
PLANTS.				
Diatomaceæ,	**16**	**pr.**	**3**	**2**
Asterionella,	2	0	0	0
Epithemia,	2	0	0	0
Navicula,	0	0	0	2
Pinnularia,	2	0	0	0
Synedra,	10	pr.	3	0
Cyanophyceæ,	**0**	**22**	**0**	**4**
Chroöcoccus,	0	22	0	0
Oscillaria,	0	0	0	4
Algæ,	**66**	**14**	**334**	**2**
Chlorococcus,	60	14	314	0
Eudorina,	2	pr.	5	0
Gonium,	0	0	5	0
Raphidium,	0	0	4	0
Scenedesmus,	4	0	6	0
Spirogyra,	0	0	0	2
Fungi. Crenothrix,	**600**	**190**	**156**	**192**

NEPONSET RIVER.

Microscopical Examination — Concluded.

[Number of organisms per cubic centimeter.]

	1890.			
	July.	July.	Aug.	Aug.
ANIMALS.				
Infusoria,	**2**	**38**	**6**	**0**
Dinobryon,	0	34	2	0
Euglena,	0	pr.	pr.	0
Monas,	0	2	0	0
Peridinium,	0	1	0	0
Trachelomonas,	2	1	4	0
TOTAL ORGANISMS,	684	264	499	200

STONY BROOK.

Chemical Examination of Water from Stony Brook, at Jamaica Plain, Boston.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6616	Oct. 20	Oct. 21	Dec'd.	Heavy, e'thy & floc't.	0.90	-	-	.0042	.0410	.0304	.0106	.92	.0700	.0009	3.38

Odor, musty. —— The sample was collected from the brook at the Sturtevant Blower Works, Jamaica Plain. The brook was full from recent rains.

Microscopical Examination.

Diatomaceæ, *Cymbella*, 1; *Diatoma*, 2; *Fragillaria*, 3; *Navicula*, 11; *Pleurosigma*, 1; *Synedra*, 3. Fungi, *Crenothrix*, 15. Total organisms, 36.

Chemical Examination of Water from Stony Brook at Inlet to Conduit, Roxbury.

[Parts per 100,000.]

Number.	Date of		Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
									Albuminoid.						
	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
	1890.														
6359	Aug. 5	Aug. 5	Dec'd.	Heavy, rusty.	0.15	18.10	3.55	.0680	.0450	.0280	.0170	2.05	.1250	.0120	8.14

Odor, decidedly musty. —— The sample was collected from the brook just above the gate-house.

Microscopical Examination.

Diatomaceæ, *Melosira*, 4; *Stephanodiscus*, 8; *Synedra*, 6. Fungi, *Crenothrix*, 568. Infusoria, *Trachelomonas*, 2. Total organisms, 588.

TAUNTON RIVER.

Analyses of the Taunton River at Taunton may be found on pages 255 and 256.

Chemical Examination of Water from Mill River, at Taunton.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6282	July 23	July 24	Slight.	Cons., e'rthy, floc't.	1.20	8.00	–	.1360	.0760	.0416	.0344	.98	.0250	.0021	1.95
6283	July 23	July 24	Slight.	Cons., e'rthy, floc't.	1.20	6.50	–	.0304	.0508	.0370	.0138	.68	.0125	.0012	1.76

Odor, decidedly musty. Sample No. 6282 was collected from the river just above the last dam above its confluence with the Taunton River. No. 6283 was collected from the river just above Weir bridge.

Microscopical Examination

No. 6282. Diatomaceæ, *Pinnularia*, 2; *Synedra*, 18. Cyanophyceæ, *Aphanocapsa*, 2; *Oscillaria*, 2. Algæ, *Chlorococcus*, 6; *Sphærozosma*, 2. Total organisms, 32.

No. 6283. Diatomaceæ, *Navicula*, 4; *Pinnularia*, 4; *Cyclotella*, 2; *Synedra*, 6. Algæ, *Chlorococcus*, 6. Fungi, *Crenothrix*, 160. Infusoria, *Peridinium*, 2; *Trachelomonas*, 2. Total organisms, 186.

TEN MILE RIVER.

Chemical Examination of Water from the Ten Mile River, at Attleborough.

[Parts per 100,000.]

	DATE OF		APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS		
									Albuminoid.						
Number.	Collection.	Examination.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Hardness.
	1890.														
6272	July 22	July 22	Slight.	Cons., e'thy & floc't.	0.25	4.20	–	.0040	.0442	.0318	.0124	.43	.0020	.0003	1.45

Odor, vegetable and grassy.—The sample was collected from the river immediately in front of the well of the Attleborough Fire District. The river was said to be very low on account of a prolonged drought.

Microscopical Examination.

Diatomaceæ, *Epithemia*, 5; *Gomphonema*, 1; *Melosira*, 2; *Navicula*, 2; *Cyclotella*, 3; *Synedra*, 14; *Tabellaria*, 2. Cyanophyceæ, *Anabæna*, 1; *Clathrocystis*, 1. Algæ, *Chlorococcus*, 53; *Closterium*, 1; *Scenedesmus*, 4; *Sphærozosma*, 1; *Staurastrum*, 1. Fungi, *Crenothrix*, 92. Infusoria, *Cyclidium*, 3; *Dinobryon*, 153; *Peridinium*, 10; *Trachelomonas*, 4. Vermes, *Rotatorian ova*, 1. Total organisms, 354.

SUMMARY

OF

WATER SUPPLY STATISTICS;

ALSO

RECORDS OF RAINFALL AND FLOW OF STREAMS.

SUMMARY OF WATER SUPPLY STATISTICS.

The summary of water supply statistics given on pages 626–628 of Part I. of the special report of the Board upon the Examination of Water Supplies, 1890, represented the conditions existing at the end of 1889. The State then contained 25 cities and 326 towns, of which all of the cities and 107 towns, a total of 132 places, were wholly or in part provided with a public water supply.

During 1890 a public water supply was introduced into the towns of Andover, Bradford, Cottage City, Milton and Needham.

The towns of Marlborough, Chicopee and Pittsfield became cities during this year, so that at the end of 1890 the State contained 28 cities and 323 towns, of which all of the cities and 109 towns, a total of 137 places, were provided with a public water supply. During this year also the national census of population was taken.

The following table gives a classification, by population, of cities and towns having and not having public water supplies Dec. 31, 1890. The populations are taken from the census of 1890.

POPULATION **(1890)**.	Number of Places of Given Population having a Public Water Supply.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having a Public Water Supply.	Total Population of Places in Preceding Column.
Under 500,	0	–	28	9,772
500-1,000,	4	3,780	63	48,453
1,000-1,500,	4	4,948	44	54,105
1,500-2,000,	8	13,574	28	50,171
2,000-2,500,	9	19,987	14	30,299
2,500-3,000,	5	14,111	20	54,814
3,000-3,500,	7	22,890	6	19,019
3,500-4,000,	6	22,457	3	11,263
4,000-4,500,	10	43,113	6	25,455
4,500-5,000,	13	60,954	1	4,642
5,000-5,500,	5	25,739	0	–
5,500-6,000,	2	11,297	0	–
Above 6,000,	64	1,681,962	1	6,138
	137	1,924,812	214	314,131

From the totals given in this table it will be seen that, although but 39 per cent. of the cities and towns in the State have a public water supply, yet the total population of places supplied represents

86 per cent. of the whole population of the State. In this estimate, of the total population of the municipalities supplied, all of the inhabitants in them are included, and it consequently includes rather more than the actual number of persons to whom a public water supply is available; the difference, however, is not large. There are now but eight towns having a population exceeding 4,000 which are not provided with a public water supply. These are given in the following table:—

TOWNS.	Population in 1890.	TOWNS.	Population in 1890.
Barnstable,	4,023	Millbury,	4,428
Rockport,	4,087	Ipswich,	4,439
Reading,*	4,088	Provincetown,	4,642
Winchendon,	4,390	Blackstone,	6,138

* Works for the supply of Reading were nearly completed at the end of 1890.

In the State there are 132 sources of public water supply divided as follows:—

Ground Water Sources.

Springs,	14
Large wells,	22
Tubular wells,	7
Filter-galleries,	10
Filter-basins,	4
TOTAL,	57

Surface Water Sources.

Artificial storage reservoirs,	38
Natural ponds,	33
Streams,	4
TOTAL,	75

In the following table the various water supplies are classified according to the dates when a fairly complete system of supply was first introduced into a city or town.

YEARS.	Number of Places Supplied.	YEARS.	Number of Places Supplied.
Previous to 1850,	6	1880-1889, inclusive,	68
1850-1859, inclusive,	4	1890,	5
1860-1869, inclusive,	10		
1870-1879, inclusive,	44	TOTAL,	137

Of the 28 cities in the Commonwealth, 23, having a total population in 1890 of 1,275;517, own their water works; while 5, having a total population of 96,783, are wholly supplied by private companies. Of the 109 towns having public water supplies, 59, with a total population of 330,976, are supplied from their own works, while 50, with a total population of 221,536, are supplied by private companies. The total population in both cities and towns owning their works is 1,606,493 against 318,319 in those supplied by private companies.

RAINFALL.

During the months covered by the analyses printed in this report the rainfall has been unusually large and the distribution has been such that the summer flow of the streams has been high. This is particularly the case in the summer of 1889 when the streams were at all times far above the ordinary summer level. In 1890 the rainfall was below the average in June and July and but little above the average in August, which caused a low flow in the streams during the last two of these months. The average annual rainfall* in Massachusetts deduced from long continued observations in various parts of the State is 44.26 inches. In the following table the normal and actual rainfall for each month from June, 1889, to December, 1890, are given, together with the departures from the normal in each month† : —

	Normal Rainfall.	Rainfall June, 1889, to Dec., 1890.	Excess or Deficiency.
1889.			
June,	3.30	3.87	+0.57
July,	3.95	8.04	+4.09
August,	4.28	3.75	−0.53
September,	3.44	3.88	+0.44
October,	3.81	4.23	+0.42
November,	3.90	5.83	+1.93
December,	3.49	2.85	−0.64
1890.			
January,	3.74	2.67	−1.07
February,	3.57	3.69	+0.12
1890 — Con.			
March,	3.98	6.74	+2.76
April,	3.28	2.43	−0.85
May,	3.52	5.42	+1.90
June,	3.30	2.67	−0.63
July,	3.95	3.13	−0.82
August,	4.28	4.67	+0.39
September,	3.44	6.77	+3.33
October,	3.81	7.80	+3.99
November,	3.90	1.30	−2.60
December,	3.49	4.07	+0.58

To enable the condition preceding the collection of samples of water in any part of the State to be understood, the following tables are presented, which give the daily rainfall in inches at nine stations scattered about the State.

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* Including melted snow.

† This and subsequent tables of rainfall have been prepared from the records of the New England Meteorological Society.

DAILY RAINFALL AT NINE PLACES IN MASSACHUSETTS GEOGRAPHICALLY SELECTED.

June, 1889. **July, 1889.**

DAY OF MONTH.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill Boston.	Lawrence.	Salem.	Taunton.	New Bedford.	DAY OF MONTH.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.25	0.15	–	*	–	–	–	–	*	1, . .	–	–	–	–	–	–	–	–	–
2, . .	1.10	1.17	0.95	1.10	1.59	1.31	1.37	1.12	*	2, . .	0.15	0.03	0.03	*	–	–	0.01	0.02	*
3, . .	–	–	–	–	*	0.67	*	*	1.92	3, . .	0.90	0.96	0.85	*	0.58	0.52	0.68	0.91	*
4, . .	0.06	0.27	0.29	0.94	0.34	–	0.60	0.46	0.67	4, . .	0.40	0.53	0.27	1.62	0.23	0.06	0.15	0.05	0.55
5, . .	0.01	0.02	–	0.42	0.47	0.06	0.59	–	–	5, . .	–	–	–	–	–	–	–	0.02	0.05
6, . .	0.05	–	–	–	–	–	–	–	–	6, . .	–	–	–	–	–	–	–	–	–
7, . .	–	–	–	–	–	–	–	–	–	7, . .	0.02	0.10	0.02	0.04	–	–	–	–	–
8, . .	0.50	0.50	0.24	0.16	0.21	0.23	0.32	0.07	0.01	8, . .	0.75	–	–	*	–	–	–	–	–
9, . .	0.02	0.04	–	–	–	–	–	–	–	9, . .	0.03	–	0.05	*	–	–	–	–	–
10, . .	0.92	0.93	0.54	0.11	0.06	0.30	0.15	–	–	10, . .	0.25	0.46	0.09	*	–	–	–	0.03	–
11, . .	0.30	0.37	0.31	0.07	0.04	–	0.03	0.18	0.50	11, . .	0.03	0.10	0.18	*	0.06	0.11	0.06	0.06	*
12, . .	0.06	0.07	0.02	–	–	0.04	–	0.01	0.04	12, . .	–	–	0.01	0.22	–	–	–	0.01	0.10
13, . .	–	–	0.04	–	–	–	–	–	–	13, . .	–	–	–	–	–	–	–	–	–
14, . .	–	–	0.02	–	–	–	–	–	–	14, . .	–	–	–	–	–	–	–	–	–
15, . .	0.13	0.20	–	0.11	0.15	0.01	*	–	0.02	15, . .	1.12	1.17	0.77	1.53	1.34	0.87	0.59	1.54	1.40
16, . .	0.12	–	–	–	–	–	0.05	–	–	16, . .	–	–	–	–	–	–	–	0.01	–
17, . .	0.55	0.40	0.11	0.48	0.45	0.16	0.26	0.10	0.22	17, . .	–	–	–	–	0.75	0.35	0.52	0.01	–
18, . .	–	–	–	–	–	–	–	–	–	18, . .	–	–	–	–	–	–	–	–	–
19, . .	–	–	–	–	–	–	–	–	–	19, . .	0.15	*	0.01	–	–	–	–	–	–
20, . .	–	–	–	–	–	–	–	–	–	20, . .	0.85	1.33	1.32	1.17	1.15	2.33	1.33	1.74	1.30
21, . .	–	–	–	–	–	–	–	–	*	21, . .	–	–	–	–	–	–	–	–	–
22, . .	0.03	–	–	–	–	–	–	–	0.13	22, . .	–	–	–	–	–	–	–	–	–
23, . .	–	–	–	–	–	–	–	–	–	23, . .	0.15	0.92	0.20	*	0.32	0.65	0.24	1.84	0.18
24, . .	–	–	–	–	–	–	–	–	–	24, . .	–	–	–	0.20	0.03	–	–	–	–
25, . .	–	–	–	–	–	–	–	–	–	25, . .	–	–	–	–	–	–	–	–	–
26, . .	0.05	–	0.05	0.03	–	–	–	–	0.01	26, . .	–	–	–	–	–	–	–	–	–
27, . .	0.20	–	0.04	–	–	–	–	–	–	27, . .	1.80	1.39	1.68	*	2.48	–	*	1.41	0.02
28, . .	0.02	0.06	–	–	–	0.65	–	–	–	28, . .	–	0.09	–	2.31	–	1.14	2.15	0.02	1.74
29, . .	–	–	0.01	–	–	–	0.52	–	–	29, . .	1.00	0.70	0.50	0.18	0.78	0.02	–	0.46	0.10
30, . .	–	–	–	–	–	–	–	–	–	30, . .	0.65	1.05	0.79	1.19	1.01	0.31	0.81	0.16	–
										31, . .	0.80	0.80	0.40	0.88	0.50	0.68	0.23	0.17	–
TOTALS,	4.37	4.18	2.62	3.42	3.31	3.43	3.89	1.94	3.52	TOTALS,	9.05	9.63	7.17	9.34	9.23	7.04	6.77	8.47	7.51

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

August, 1889.										September, 1889.									
Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.57	1.28	0.64	0.83	1.98	0.90	No record.	1.50	1.88	1, . .	-	-	-	-	-	-	-	-	-
2, . .	0.05	0.40	-	-	-	-		0.05	0.33	2, . .	-	-	-	-	-	-	-	-	-
3, . .	0.09	1.22	0.32	0.03	0.45	0.21		2.67	0.61	3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	0.04	-	-	-	-		-	-	4, . .	-	-	-	-	-	-	-	-	-
5, . .	0.10	0.20	0.24	0.61	0.13	0.24		0.28	0.48	5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	0.02	-	-	-	-		0.16	-	6, . .	0.04	0.31	0.69	-	-	-	-	-	-
7, . .	-	-	-	-	-	-		0.01	0.17	7, . .	0.05	-	0.01	-	-	-	-	-	-
8, . .	-	-	-	-	-	-		-	-	8, . .	-	-	-	-	-	-	-	-	-
9, . .	0.20	-	0.05	0.34	0.29	0.04		0.05	-	9, . .	-	-	-	-	-	-	-	-	-
10, . .	0.10	0.20	0.02	-	-	0.02		0.17	-	10, . .	-	-	-	-	-	-	*	-	*
11, . .	-	-	-	-	-	-		-	-	11, . .	0.20	*	0.19	*	*	-	0.05	0.36	0.14
12, . .	0.02	-	0.01	-	-	-		-	-	12, . .	0.45	1.05	0.18	1.18	1.35	-	0.03	0.53	0.90
13, . .	0.05	0.03	0.01	*	*	-		-	-	13, . .	0.25	*	-	*	*	-	-	0.05	0.08
14, . .	1.00	2.90	0.94	2.50	1.60	-		1.61	1.29	14, . .	0.07	0.29	0.50	*	1.01	0.93	0.78	0.17	*
15, . .	0.05	0.06	0.03	-	-	1.59		0.04	-	15, . .	0.05	-	0.11	1.05	0.01	0.04	0.08	0.05	0.19
16, . .	-	-	-	-	-	-		-	-	16, . .	-	-	0.04	-	0.01	0.16	0.03	-	-
17, . .	-	-	-	-	-	-		-	-	17, . .	0.80	0.23	0.08	-	-	-	-	-	-
18, . .	-	-	-	-	-	-		-	-	18, . .	1.20	1.24	0.50	*	*	-	0.62	0.05	*
19, . .	0.02	-	-	-	-	-		-	-	19, . .	0.37	0.57	0.81	1.65	2.23	1.59	0.83	1.20	1.45
20, . .	0.02	-	-	-	-	-		-	0.02	20, . .	0.10	0.08	0.01	*	*	-	-	-	-
21, . .	-	-	-	-	-	-		-	-	21, . .	0.12	-	0.03	0.12	0.24	0.29	0.16	0.47	0.23
22, . .	0.01	-	-	-	-	-		-	-	22, . .	-	-	-	-	-	-	0.11	-	-
23, . .	-	-	-	*	*	-		*	*	23, . .	-	-	-	-	-	-	-	-	-
24, . .	0.10	-	-	0.18	0.36	-		0.85	0.95	24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-		-	-	25, . .	0.01	-	-	-	-	-	-	-	*
26, . .	-	-	-	-	-	-		-	-	26, . .	0.20	0.28	0.19	-	*	-	0.11	0.05	-
27, . .	-	-	-	-	-	-		-	-	27, . .	0.03	0.23	-	-	0.25	0.31	-	0.06	0.16
28, . .	-	-	-	-	-	-		-	-	28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	-	-	-	-	-		-	-	29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-		-	-	30, . .	0.10	-	0.01	0.24	0.20	-	-	0.02	0.72
31, . .	-	-	-	-	-	-		-	-										
Totals,	2.38	6.35	2.31	4.49	4.81	3.00		7.74	3.58	Totals,	4.04	4.28	3.35	4.24	5.30	3.32	2.80	3.02	4.12

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

October, 1889. **November, 1889.**

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	1.05	1.31	0.82	0.41	0.08	0.43	0.19	0.23	–	1, . .	0.20	0.27	0.19	–	0.02	0.08	0.18	0.20	–
2, . .	–	0.15	–	–	–	–	–	–	–	2, . .	0.10	0.14	0.04	*	–	–	*	0.01	*
3, . .	0.03	–	–	–	–	–	–	–	–	3, . .	0.92	1.01	0.71	0.39	0.46	0.69	0.37	0.71	0.68
4, . .	–	–	–	0.02	–	0.03	–	–	–	4, . .	–	–	–	–	–	–	–	–	–
5, . .	–	–	–	–	–	–	–	–	–	5, . .	–	–	–	–	–	–	–	–	–
6, . .	0.75	*	0.82	*	*	–	–	*	*	6, . .	–	–	–	–	–	–	–	–	–
7, . .	0.60	1.09	0.55	1.43	0.71	0.84	0.57	0.87	0.60	7, . .	–	–	–	–	–	–	–	–	–
8, . .	–	–	–	–	–	–	–	–	–	8, . .	–	–	–	–	–	–	–	–	–
9, . .	–	–	–	–	–	–	–	–	–	9, . .	0.05	0.03	0.15	*	*	–	0.03	0.62	*
10, . .	0.20	–	0.07	0.04	–	0.06	–	–	0.14	10, . .	0.12	0.15	0.13	0.30	0.36	0.48	0.35	0.60	1.56
11, . .	–	0.25	–	–	–	–	–	–	–	11, . .	0.08	0.05	0.06	0.14	–	0.05	0.02	–	–
12, . .	0.20	0.80	0.04	*	*	–	*	0.21	*	12, . .	–	0.11	–	–	–	–	–	0.02	–
13, . .	0.70	–	1.42	1.41	1.47	1.00	1.25	1.32	1.22	13, . .	0.40	0.33	0.29	*	0.30	–	0.59	0.27	0.24
14, . .	–	–	–	0.25	0.35	–	0.22	0.70	*	14, . .	0.03	–	0.03	0.32	–	0.53	–	0.01	–
15, . .	0.02	–	–	–	–	–	–	0.13	0.78	15, . .	–	–	–	–	–	–	–	–	–
16, . .	–	–	–	–	–	–	–	–	–	16, . .	–	–	–	–	–	–	–	–	–
17, . .	–	–	–	–	–	–	–	–	–	17, . .	–	–	–	–	–	–	–	–	–
18, . .	–	–	–	–	–	–	–	–	–	18, . .	0.03	–	–	–	–	–	–	–	–
19, . .	–	–	–	–	–	–	–	–	–	19, . .	0.12	0.20	0.86	*	2.08	–	*	1.28	*
20, . .	–	–	0.07	–	–	–	–	–	–	20, . .	0.70	0.32	0.71	1.52	0.10	1.10	1.17	0.19	1.48
21, . .	0.05	0.08	0.07	0.08	0.06	0.43	–	0.11	0.24	21, . .	0.10	0.28	0.04	*	0.05	0.07	0.03	0.24	–
22, . .	–	–	–	–	–	–	–	–	–	22, . .	0.50	0.55	0.37	0.51	0.44	0.48	*	–	–
23, . .	–	–	–	–	–	–	–	–	–	23, . .	0.05	0.03	–	–	–	–	0.44	0.27	–
24, . .	–	–	–	–	–	–	–	–	–	24, . .	–	–	–	–	–	–	–	–	–
25, . .	–	–	–	–	–	–	–	–	–	25, . .	–	–	–	–	–	–	–	0.03	–
26, . .	0.05	–	0.01	0.06	–	–	–	–	–	26, . .	–	–	–	–	–	–	–	–	–
27, . .	0.90	0.70	1.00	–	*	–	*	1.00	0.86	27, . .	0.20	*	0.06	*	*	0.05	*	0.07	*
28, . .	0.43	0.97	0.17	–	0.96	0.83	1.21	0.06	–	28, . .	2.25	2.44	2.58	3.10	2.44	2.95	2.97	2.17	2.11
29, . .	0.02	–	0.03	0.76	0.05	–	0.36	0.10	–	29, . .	–	–	–	–	–	–	–	–	–
30, . .	0.01	–	–	–	–	0.59	0.04	–	–	30, . .	–	–	–	–	–	–	–	–	–
31, . .	0.07	–	0.01	0.19	0.15	–	–	0.02	0.27										
TOTALS,	5.08	5.35	5.08	4.65	3.83	4.21	3.84	4.75	3.88	TOTALS,	5.85	5.91	6.22	6.28	6.25	6.48	6.15	6.69	6.59

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

December, 1889.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	–	–	–	–	–	–	–	No record.	–
2,	–	–	–	–	–	–	–		–
3,	0.15	0.16	0.01	0.11	–	0.09	0.06		*
4,	–	–	–	–	–	–	0.01		*
5,	0.20	0.20	0.11	0.18	0.13	–	*		*
6,	0.10	–	–	–	–	0.10	0.12		0.23
7,	–	–	–	–	–	–	–		–
8,	0.35	0.32	0.38	*	*	–	*		*
9,	0.80	0.96	0.57	0.67	0.58	0.69	0.58		0.82
10,	0.05	–	–	–	–	–	–		–
11,	0.35	0.40	0.31	0.27	0.20	0.35	0.23		0.09
12,	–	–	–	–	–	–	–		–
13,	–	–	–	–	–	–	–		–
14,	0.25	0.49	0.36	0.48	*	0.44	0.42		*
15,	0.10	–	–	–	0.36	–	–		0.60
16,	–	–	–	–	–	–	–		–
17,	–	–	–	–	*	–	–		–
18,	0.05	–	0.15	*	*	–	*		0.38
19,	0.35	0.42	0.47	0.65	0.53	0.77	0.74		–
20,	–	–	*	0.02	–	0.01	–		–
21,	–	–	0.02	–	–	–	–		–
22,	0.37	0.34	0.29	0.28	0.25	0.26	0.21		0.06
23,	–	–	–	–	–	–	–		–
24,	*	–	0.03	*	*	–	*		–
25,	0.50	0.57	0.46	0.37	0.43	0.46	0.39		0.36
26,	0.07	–	0.05	0.05	0.02	0.03	0.03		0.13
27,	–	–	–	–	–	–	–		–
28,	–	–	–	–	–	–	–		–
29,	0.05	0.06	0.01	*	0.07	–	*		–
30,	0.05	–	–	0.07	–	0.02	0.03		–
31,	–	–	–	–	–	–	–		–
Totals,	3.79	3.92	3.22	3.15	2.66	3.22	2.82		2.62

January, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	0.05	–	–	–	–	–	–	–	–
2,	–	–	–	–	–	–	–	–	–
3,	–	–	–	–	–	–	–	–	–
4,	–	–	–	–	–	–	–	–	–
5,	0.10	0.16	0.21	*	0.13	–	*	0.08	0.05
6,	0.05	0.14	0.11	0.19	0.09	0.42	0.37	0.02	–
7,	–	–	0.05	–	–	–	–	–	–
8,	0.02	–	–	–	–	–	–	0.03	–
9,	–	–	–	–	–	–	*	–	–
10,	0.05	*	0.13	*	0.17	0.13	0.21	0.23	0.20
11,	0.50	0.63	0.53	0.63	*	0.53	0.37	0.25	*
12,	0.05	–	0.01	–	0.36	–	*	–	0.21
13,	0.10	0.16	0.10	0.04	–	0.05	0.14	–	–
14,	–	–	–	–	–	–	–	–	–
15,	0.75	*	0.77	*	*	–	0.32	0.99	*
16,	0.33	1.20	0.28	0.74	0.81	0.69	0.23	0.36	1.27
17,	–	–	–	–	–	–	–	–	–
18,	–	–	–	–	–	–	–	–	–
19,	–	–	–	–	–	–	–	–	–
20,	0.13	–	0.10	0.08	0.05	0.08	0.04	0.13	0.12
21,	–	–	–	–	–	–	–	–	–
22,	–	–	0.03	–	–	–	–	–	–
23,	0.10	–	0.08	0.09	0.08	0.05	0.05	0.08	0.12
24,	–	–	–	–	–	–	–	–	–
25,	–	–	–	–	–	–	–	–	–
26,	–	–	–	*	–	–	–	–	–
27,	0.67	–	0.60	0.52	0.57	0.39	0.46	0.60	0.46
28,	–	–	–	–	–	–	–	–	–
29,	–	–	–	–	–	–	–	–	–
30,	0.22	–	0.06	*	0.23	0.16	0.23	0.31	0.23
31,	0.05	0.09	0.07	0.25	0.03	–	0.02	0.01	–
Totals,	3.17	3.42	2.54	3.13	2.52	2.47	2.44	3.09	2.78

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

February, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	–	–	–	–	–	–	–	0.02	–
2,	0.03	–	0.01	*	*	–	*	0.03	0.15
3,	0.07	0.08	0.06	0.13	0.11	0.13	0.09	0.03	–
4,	0.23	0.07	0.16	*	0.17	0.11	*	0.02	0.02
5,	–	0.08	0.01	0.18	–	–	0.12	–	–
6,	–	–	–	–	–	–	–	–	–
7,	–	–	–	*	–	–	–	–	*
8,	1.91	1.72	1.16	0.85	0.84	0.97	0.73	1.55	0.78
9,	–	–	–	–	–	–	–	–	–
10,	0.02	0.19	0.02	0.07	0.08	0.03	0.02	0.02	–
11,	–	–	–	–	–	–	–	–	–
12,	–	0.07	–	–	–	–	–	–	–
13,	–	–	–	–	–	–	–	–	–
14,	0.10	0.32	0.33	0.25	0.30	–	*	0.54	0.52
15,	0.35	–	–	–	–	0.16	0.29	–	–
16,	–	–	–	–	–	–	–	–	–
17,	–	–	–	–	*	–	–	–	–
18,	0.20	0.05	0.38	*	*	0.44	0.26	0.16	0.07
19,	–	–	0.04	0.24	0.25	0.05	–	0.14	*
20,	0.46	–	0.72	0.68	0.64	0.87	0.85	0.47	0.52
21,	–	–	–	–	–	–	–	–	–
22,	–	–	–	–	–	–	–	–	–
23,	–	–	–	–	–	–	–	–	0.01
24,	0.10	0.08	0.04	*	*	0.05	*	0.04	*
25,	0.40	–	0.49	*	*	–	0.05	0.25	*
26,	0.30	0.10	0.09	0.80	0.57	0.69	0.70	0.15	0.28
27,	–	–	–	–	–	–	–	–	–
28,	0.35	0.30	0.17	0.40	0.16	–	0.10	0.20	0.50
Totals,	4.52	2.96	3.68	3.60	3.12	3.50	3.21	3.62	2.85

March, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	0.30	0.23	0.18	*	*	0.49	*	0.45	0.27
2,	0.05	0.09	0.11	*	*	0.07	0.63	*	–
3,	0.25	0.31	0.41	1.18	1.42	0.82	0.55	0.45	1.00
4,	–	–	–	–	–	–	–	–	–
5,	0.14	0.12	0.12	0.06	–	0.04	–	–	0.01
6,	0.40	0.98	0.76	0.88	0.70	0.60	0.54	0.57	0.42
7,	–	–	–	–	–	–	–	–	–
8,	–	–	–	–	–	–	–	–	–
9,	–	–	–	–	–	–	–	–	–
10,	–	–	–	–	–	–	–	–	–
11,	0.10	0.07	0.05	*	–	–	0.08	*	0.54
12,	–	0.03	0.01	0.10	–	0.07	–	0.27	–
13,	–	–	–	–	–	–	–	–	*
14,	0.70	0.69	0.61	*	*	–	0.75	*	*
15,	0.50	0.69	0.59	1.44	*	1.33	*	1.66	1.31
16,	–	0.03	–	–	1.56	–	0.83	–	–
17,	–	–	–	–	–	–	–	–	–
18,	–	–	–	–	–	–	–	–	–
19,	0.20	0.46	0.45	0.54	0.63	0.32	0.47	0.28	0.38
20,	–	–	–	–	–	–	–	–	–
21,	0.17	0.20	0.07	*	0.04	0.06	0.05	–	0.05
22,	1.00	0.80	0.82	0.06	*	–	*	1.24	*
23,	0.75	0.98	0.85	2.19	1.68	1.45	1.66	0.63	1.80
24,	–	–	–	–	–	–	–	–	–
25,	0.40	–	0.13	*	*	–	*	–	–
26,	0.20	0.65	0.34	0.35	0.40	0.45	0.34	0.35	0.63
27,	–	–	–	–	–	–	–	–	–
28,	1.00	*	0.48	*	*	–	0.99	1.53	1.63
29,	0.05	0.84	0.09	0.80	1.15	0.81	*	0.08	0.01
30,	–	–	–	–	–	–	0.08	–	–
31,	–	–	–	*	0.06	–	–	–	0.20
Totals,	6.21	5.15	6.07	7.68	7.64	6.51	6.97	7.73	8.17

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

April, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.10	0.07	0.03	–	0.09	0.07	0.08	0.22	–
2, . .	–	–	–	–	–	–	–	–	–
3, . .	–	–	–	–	–	–	–	–	–
4, . .	0.29	0.51	0.16	*	0.17	0.12	*	1.05	*
5, . .	–	0.03	–	0.18	–	0.04	0.18	0.05	1.07
6, . .	–	–	–	–	–	–	–	–	–
7, . .	0.10	0.36	0.32	0.41	0.46	0.24	0.31	0.34	0.21
8, . .	0.28	0.37	0.30	*	*	–	*	0.13	*
9, . .	0.46	0.45	0.31	*	0.96	–	0.71	0.18	0.32
10, . .	–	0.02	0.01	0.90	–	0.58	–	–	–
11, . .	–	–	–	–	–	–	–	–	–
12, . .	–	–	–	–	–	–	–	–	–
13, . .	–	–	–	–	–	–	–	–	–
14, . .	–	–	0.06	–	–	–	–	–	–
15, . .	–	–	–	–	–	0.04	–	–	–
16, . .	–	–	–	–	–	–	–	–	–
17, . .	–	–	–	–	–	–	–	–	–
18, . .	–	–	–	–	–	–	–	–	–
19, . .	–	–	–	–	–	–	–	–	–
20, . .	–	–	–	–	–	–	–	–	–
21, . .	–	–	–	–	–	–	–	–	–
22, . .	–	–	–	–	–	–	–	–	–
23, . .	–	–	–	–	–	–	–	–	–
24, . .	–	0.04	–	*	–	–	*	*	0.16
25, . .	0.25	0.20	0.04	0.21	0.15	0.03	0.30	0.25	0.16
26, . .	0.05	0.10	0.04	*	*	–	–	*	*
27, . .	0.65	0.78	0.60	0.93	1.10	–	*	1.70	*
28, . .	0.05	0.07	0.01	–	–	0.66	0.83	0.04	1.73
29, . .	–	–	–	–	–	–	–	–	–
30, . .	–	–	–	–	–	0.02	–	–	–
Totals,	2.23	3.00	1.88	2.63	2.93	1.80	2.41	3.96	3.65

May, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.10	0.06	0.08	0.18	0.20	0.16	*	*	0.19
2, . .	0.05	–	–	–	–	–	0.16	0.07	–
3, . .	–	–	–	–	–	–	–	–	–
4, . .	0.10	0.23	0.23	*	*	–	*	0.55	0.83
5, . .	0.60	0.87	0.45	0.89	0.77	1.23	0.98	1.00	0.53
6, . .	0.79	0.82	0.70	0.64	0.97	0.57	1.04	1.23	1.97
7, . .	–	–	–	–	–	–	–	–	–
8, . .	0.04	0.03	0.09	0.21	0.42	0.45	0.36	0.24	0.28
9, . .	–	–	–	–	–	–	–	0.02	–
10, . .	0.15	0.19	0.04	*	*	0.04	0.02	0.02	*
11, . .	0.50	0.49	0.37	0.31	0.25	0.31	0.24	0.26	0.26
12, . .	–	–	–	–	–	–	–	–	0.01
13, . .	*	–	–	0.08	–	–	–	–	–
14, . .	0.30	0.12	0.74	*	0.43	0.06	0.05	–	0.14
15, . .	0.50	0.56	0.29	0.77	0.41	0.18	*	0.38	0.14
16, . .	0.08	0.10	0.25	0.05	0.03	0.61	0.63	0.02	–
17, . .	0.05	0.11	0.04	–	–	–	–	–	–
18, . .	–	–	–	–	–	–	–	–	–
19, . .	–	–	0.27	–	–	–	–	–	0.11
20, . .	0.60	0.43	–	0.53	0.85	0.41	0.29	0.60	0.78
21, . .	–	–	–	–	–	–	–	–	–
22, . .	–	–	–	–	–	–	–	–	–
23, . .	–	–	–	–	–	–	–	–	–
24, . .	–	–	–	–	–	–	–	–	–
25, . .	–	–	–	–	–	–	–	–	–
26, . .	0.30	0.42	0.26	*	*	–	–	–	*
27, . .	1.30	1.66	1.56	1.10	1.33	1.39	*	1.32	1.15
28, . .	0.10	–	0.17	0.18	0.14	0.13	1.57	0.05	0.11
29, . .	–	–	–	–	–	–	–	–	0.02
30, . .	–	–	–	–	–	–	–	–	–
31, . .	–	–	–	–	–	–	–	–	–
Totals,	5.56	6.09	5.54	4.94	5.80	5.54	5.65	5.76	6.52

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

June, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	0.05	-	-	-	-	-	-	0.06	0.06
4, . .	0.55	0.51	0.35	0.25	0.35	0.24	0.39	0.28	*
5, . .	0.62	0.17	0.47	*	0.34	0.63	0.52	0.02	*
6, . .	0.70	1.17	0.27	*	0.16	0.41	0.18	0.92	1.29
7, . .	0.05	0.07	0.04	0.45	-	0.32	0.38	-	-
8, . .	-	-	-	-	-	-	-	-	-
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	0.25	-	-	0.02	0.86	-	-
12, . .	0.10	0.09	0.14	*	*	-	0.29	0.07	*
13, . .	-	0.06	0.41	*	1.43	-	1.15	2.05	3.77
14, . .	0.10	-	-	1.10	-	1.36	0.02	0.07	0.02
15, . .	0.05	0.03	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	0.35	-	-	-	-	-	-	-	*
20, . .	-	-	-	-	-	-	-	-	0.13
21, . .	0.10	-	-	-	-	-	-	-	-
22, . .	0.05	0.07	-	-	-	-	-	0.22	0.11
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	0.15	-	0.03	0.06	0.25	0.73	0.42	0.08	*
26, . .	-	-	-	-	-	-	0.10	-	0.15
27, . .	-	-	-	0.11	0.07	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-	-	-	-
TOTALS,	2.87	2.17	1.96	1.97	2.60	3.71	4.31	3.77	5.53

July, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	0.01	*	-	-	-	-	-
3, . .	0.30	0.17	0.08	0.10	-	0.02	-	0.07	0.02
4, . .	0.35	0.63	0.09	*	-	0.02	-	-	-
5, . .	-	-	-	0.27	-	0.03	0.21	0.05	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	0.20	-	0.01	0.03	0.03	0.02	0.04	-	0.07
8, . .	-	0.10	-	-	-	-	-	0.20	-
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	0.01
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	0.20	-	-	-	-	-	-	0.01	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	0.05	0.01	0.10
18, . .	-	-	-	-	-	-	-	-	-
19, . .	0.05	0.32	0.06	0.25	0.12	0.15	0.41	0.04	0.27
20, . .	-	-	-	-	0.05	0.15	0.03	0.05	0.17
21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	2.95	1.90	2.16	*	*	-	0.54	0.11	0.06
26, . .	1.50	1.37	1.23	1.30	1.64	1.76	1.04	0.54	0.61
27, . .	-	0.17	-	-	-	-	-	0.01	-
28, . .	-	0.05	-	-	-	-	-	-	-
29, . .	0.05	-	-	0.08	0.12	-	0.02	0.38	0.67
30, . .	-	-	-	-	-	-	-	-	-
31, . .	0.05	0.05	0.07	0.34	0.47	0.47	0.02	-	-
TOTALS,	5.65	4.76	3.71	2.37	2.43	2.62	2.36	1.47	1.98

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

August, 1890.										September, 1890.									
Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.46	0.57	0.10	–	0.20	0.03	0.11	0.31	0.66	1, . .	–	–	–	–	–	–	–	–	–
2, . .	–	–	–	–	–	–	–	–	–	2, . .	–	–	–	–	–	–	–	–	–
3, . .	–	–	–	–	–	–	–	–	–	3, . .	–	–	–	–	–	–	–	–	–
4, . .	–	–	–	–	–	–	–	–	–	4, . .	–	–	–	–	–	–	–	–	–
5, . .	–	–	–	–	–	–	–	–	–	5, . .	0.20	0.16	0.01	0.11	–	–	*	0.13	0.08
6, . .	–	–	–	–	0.31	0.03	0.24	0.15	0.01	6, . .	0.65	1.53	1.43	2.38	*	–	0.66	1.05	0.64
7, . .	–	–	–	–	–	–	–	–	–	7, . .	–	0.04	0.05	–	1.57	0.64	0.13	0.38	–
8, . .	–	–	–	–	–	–	–	–	–	8, . .	–	–	–	–	–	–	–	–	–
9, . .	–	0.20	0.14	*	0.20	0.15	0.15	0.61	0.76	9, . .	0.05	0.07	0.07	*	*	–	–	–	*
10, . .	0.45	0.42	0.06	0.36	0.06	0.02	0.32	0.37	0.18	10, . .	0.30	0.49	1.02	0.19	0.13	–	0.33	0.13	0.06
11, . .	–	–	–	–	–	–	–	–	–	11, . .	0.15	0.12	0.12	*	*	1.00	–	–	*
12, . .	0.10	0.28	–	–	–	0.05	–	–	–	12, . .	0.25	0.20	0.40	*	*	–	0.99	0.79	0.66
13, . .	–	–	–	–	–	–	–	–	–	13, . .	1.60	1.55	0.83	1.61	1.14	0.72	0.52	*	0.03
14, . .	–	0.16	0.18	0.08	–	–	–	–	–	14, . .	0.50	0.13	0.03	*	*	–	0.01	0.51	0.15
15, . .	–	–	–	–	–	–	–	–	0.01	15, . .	1.00	1.02	1.17	*	*	0.54	0.26	0.56	0.12
16, . .	–	–	–	–	–	–	–	–	–	16, . .	0.10	0.12	0.05	0.55	1.16	–	0.47	0.70	*
17, . .	0.32	–	0.23	*	*	–	–	–	–	17, . .	1.20	0.73	0.21	*	0.27	–	0.71	0.14	4.95
18, . .	1.00	1.60	0.55	0.64	0.49	0.50	–	0.58	0.01	18, . .	0.65	0.21	0.18	1.38	0.32	0.97	0.09	0.02	–
19, . .	0.10	0.12	0.30	*	*	–	*	0.06	–	19, . .	–	–	–	–	–	–	–	–	–
20, . .	1.40	1.72	1.35	0.69	0.75	1.90	1.06	0.44	0.11	20, . .	0.02	–	–	–	–	–	–	–	–
21, . .	–	0.03	–	0.13	–	–	–	–	–	21, . .	–	–	–	–	–	–	–	–	–
22, . .	0.20	–	0.15	*	–	0.11	0.10	0.06	–	22, . .	–	–	–	–	–	–	–	–	–
23, . .	0.50	0.52	1.03	0.61	0.38	0.86	0.12	*	–	23, . .	–	–	–	–	–	–	–	–	0.02
24, . .	0.02	0.04	–	–	–	–	0.16	0.04	–	24, . .	0.01	–	–	–	–	–	–	–	–
25, . .	–	–	–	–	–	–	–	–	–	25, . .	–	–	–	–	–	–	–	–	–
26, . .	–	–	–	–	–	0.06	–	–	*	26, . .	0.25	0.31	0.35	*	0.30	–	*	*	*
27, . .	0.95	1.39	1.32	1.05	0.91	1.20	*	1.40	2.00	27, . .	0.10	0.08	0.04	0.29	–	0.26	0.25	0.75	0.87
28, . .	–	–	–	–	–	–	1.07	–	–	28, . .	–	–	–	–	–	–	–	–	0.15
29, . .	–	–	–	–	–	–	–	–	0.01	29, . .	–	–	–	–	–	–	–	–	–
30, . .	0.41	0.91	0.66	0.16	0.07	0.12	0.23	–	–	30, . .	–	–	–	–	–	–	–	–	–
31, . .	–	–	–	–	–	–	–	–	–										
TOTALS,	5.91	7.96	6.07	3.72	3.37	5.03	3.56	4.02	3.75	TOTALS,	7.03	6.76	5.96	6.51	4.89	4.13	4.42	5.16	7.73

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Continued.

October, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	–	–	–	–	–	–	–	–	–
2,	–	–	–	–	–	–	–	–	–
3,	–	0.26	0.15	*	*	–	*	0.01	0.03
4,	0.05	0.19	0.45	2.58	1.07	1.12	1.09	1.20	0.49
5,	–	–	–	–	–	–	0.04	–	–
6,	0.02	–	–	–	–	–	–	–	–
7,	0.30	0.38	0.42	*	*	–	0.31	0.37	0.04
8,	0.32	0.39	0.55	0.71	0.72	1.80	0.27	0.23	0.43
9,	–	–	–	0.06	–	–	–	–	–
10,	0.10	0.08	0.05	0.07	–	0.06	–	*	0.19
11,	0.05	–	–	–	–	–	–	0.15	–
12,	–	–	–	–	–	–	–	–	–
13,	–	–	–	–	–	–	–	–	–
14,	0.25	0.30	0.55	*	0.44	–	0.16	0.42	0.68
15,	0.25	0.08	0.02	0.57	–	0.35	0.15	0.18	–
16,	*	–	–	–	*	–	1.04	–	–
17,	1.40	1.60	2.25	1.66	1.35	1.82	0.56	1.00	1.24
18,	–	–	–	–	–	–	0.02	–	–
19,	0.65	1.48	1.25	*	*	–	0.52	1.00	*
20,	0.26	0.24	0.84	*	2.04	–	1.40	0.26	0.83
21,	0.15	0.03	–	2.02	–	2.28	0.08	0.01	–
22,	–	–	–	–	–	–	–	–	–
23,	–	–	–	*	–	–	–	*	–
24,	1.50	1.43	1.15	*	*	–	1.22	*	4.77
25,	0.50	0.53	0.28	2.18	2.73	0.72	0.22	3.70	–
26,	–	0.21	–	–	–	–	–	–	–
27,	–	–	0.01	–	–	–	0.03	0.08	0.29
28,	–	–	–	–	–	–	–	–	–
29,	0.25	0.57	0.19	0.41	*	–	0.24	0.62	0.54
30,	0.12	0.17	0.39	–	0.43	0.53	–	–	0.20
31,	0.05	–	–	–	–	–	–	–	–
Totals,	6.22	7.94	8.55	10.26	8.78	8.68	7.35	9.23	9.73

November, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	–	–	–	–	–	–	–	–	–
2,	–	0.03	0.06	–	–	0.02	–	–	–
3,	–	–	–	–	–	–	–	–	–
4,	–	–	–	–	–	–	–	–	–
5,	–	–	–	–	–	–	–	–	–
6,	–	–	–	–	–	–	–	–	–
7,	–	–	–	–	–	–	–	–	0.02
8,	–	–	–	–	–	–	–	–	–
9,	–	–	0.01	–	–	–	–	–	–
10,	0.10	–	0.05	–	–	0.02	–	–	–
11,	0.20	0.15	0.17	*	*	–	0.16	0.24	*
12,	–	–	–	0.22	0.27	–	0.12	0.11	0.45
13,	–	–	–	–	–	0.28	–	–	0.02
14,	–	–	–	–	–	–	–	–	–
15,	0.10	0.17	0.16	0.21	*	0.22	*	0.08	0.27
16,	0.05	0.09	0.01	–	0.27	–	0.26	0.04	–
17,	0.65	0.81	0.94	*	*	1.04	0.78	0.41	0.54
18,	0.30	0.30	0.20	0.82	0.83	–	0.19	0.05	–
19,	0.01	0.03	0.03	–	–	0.03	–	–	–
20,	–	–	–	–	–	–	–	–	–
21,	–	–	–	–	–	–	–	–	–
22,	–	–	–	–	–	–	–	–	–
23,	0.10	0.10	–	–	–	0.02	–	–	–
24,	–	–	–	–	–	–	–	–	–
25,	–	–	–	–	–	–	–	–	–
26,	–	–	–	–	–	–	–	–	–
27,	–	–	–	–	–	–	–	–	–
28,	–	–	–	–	–	–	–	–	–
29,	–	–	–	–	–	–	–	–	–
30,	–	–	–	–	–	–	–	–	–
Totals,	1.51	1.68	1.63	1.25	1.37	1.63	1.51	0.93	1.30

* Precipitation included in that of following day.

Daily Rainfall at Nine Places in Massachusetts Geographically Selected — Concluded.

December, 1890.

Day of Month.	Ludlow.	Gilbertville.	Fitchburg.	Framingham.	Chestnut Hill, Boston.	Lawrence.	Salem.	Taunton.	New Bedford.
1,	–	–	–	–	–	–	–	–	–
2,	–	–	–	–	–	–	–	–	–
3,	0.05	*	0.60	*	*	–	*	–	*
4,	0.65	0.80	0.31	1.03	1.08	1.14	1.39	–	0.43
5,	0.10	*	0.09	*	*	–	*	–	0.03
6,	0.05	0.55	0.43	*	*	–	*	–	0.24
7,	0.50	–	0.09	0.28	0.23	0.63	0.54	–	–
8,	–	–	–	–	–	–	–	–	–
9,	–	–	–	–	–	–	–	–	–
10,	–	–	–	–	–	–	–	–	–
11,	–	–	–	–	–	–	–	–	–
12,	–	–	–	–	–	0.12	0.07	–	–
13,	–	–	–	–	–	–	–	–	–
14,	–	–	–	–	–	–	–	–	–
15,	–	–	–	–	–	–	–	–	–
16,	–	–	–	–	–	–	–	–	–
17,	0.20	*	0.20	*	*	–	*	–	1.64
18,	0.52	0.90	0.28	2.12	1.85	1.29	1.64	–	–
19,	–	–	–	–	–	–	–	–	–
20,	–	–	–	–	–	–	–	–	–
21,	0.15	0.03	0.01	–	–	–	–	–	0.10
22,	–	0.04	–	–	–	–	–	–	–
23,	–	–	–	–	–	–	–	–	0.02
24,	–	–	–	–	–	–	–	–	–
25,	–	–	–	–	–	–	–	–	–
26,	*	*	1.30	*	*	–	1.23	–	2.49
27,	1.15	1.30	0.40	1.72	1.60	1.78	0.75	–	–
28,	–	–	–	–	–	–	–	–	–
29,	0.02	0.08	–	–	–	–	–	–	–
30,	*	0.05	–	*	–	–	–	–	0.07
31,	0.02	–	–	0.05	–	–	–	–	–
Totals,	3.41	3.75	3.71	5.20	4.76	4.96	5.62	–	5.02

* Precipitation included in that of following day.

Flow of Streams.

With the exception of a short drought in the summer of 1890, already mentioned in discussing the rainfall, the flow of the streams has been above the normal during nearly all of the period under consideration.

This is shown by the following table, in which a comparison is made between the flow of the Sudbury River from June, 1889, to December, 1890, and the normal flow of the same river as deduced from eleven years' observations from 1879 to 1889, inclusive.

Table showing the Average Monthly Flow of Sudbury River from June, 1889, to December, 1890, inclusive, in Cubic Feet per Second per Square Mile of Drainage Area, also Departures from the Normal Flow.

Month.	Normal Flow. Cubic Feet per Second per Square Mile.	Actual Flow. Cubic Feet per Second per Square Mile.	Excess or Deficiency. Cubic Feet per Second per Square Mile.
1889.			
June,	0.734	0.978	+0.244
July,	0.298	0.980	+0.682
August,	0.489	2.215	+1.726
September,	0.442	1.233	+0.791
October,	0.692	1.903	+1.211
November,	1.154	2.907	+1.753
December,	1.572	3.467	+1.895
1890.			
January,	1.996	1.940	—0.056
February,	3.067	2.137	—0.930
March,	3.873	5.636	+1.763
April,	2.961	2.807	—0.154
May,	1.639	2.114	+0.475
June,	0.734	0.850	+0.116
July,	0.298	0.167	—0.131
August,	0.489	0.204	—0.285
September,	0.442	0.685	+0.243
October,	0.692	3.515	+2.823
November,	1.154	1.819	+0.665
December,	1.572	1.543	—0.029
Average,	1.279	1.953	+0.674

The next table shows the weekly fluctuations in the flow of the two streams most carefully measured, namely, the Sudbury and the Merrimack. The flow of these streams, particularly the Sudbury, will serve to indicate the condition of other streams in eastern Massachusetts.

Table Showing the Average Weekly Flow of the Sudbury and Merrimack Rivers, in Cubic Feet per Second per Square Mile, from June, 1889, to December, 1890, inclusive.

Week Ending Sunday.	Sudbury River. Cubic Feet per Second per Square Mile.	Merrimack River. Cubic Feet per Second per Square Mile.
1889.		
June 2,	1.821	1.386
9,	1.931	1.896
16,	0.844	1.729
23,	0.613	1.074
30,	0.320	0.694
July 7,	0.549	0.740
14,	0.333	0.610
21,	0.944	0.617
28,	1.294	1.340
Aug. 4,	3.702	1.934
11,	1.983	1.659
18,	3.221	1.167
25,	1.323	0.897
Sept. 1,	0.683	0.522
8,	0.475	0.409
15,	1.237	0.455
22,	2.194	1.228
29,	1.307	1.138
Oct. 6,	1.255	1.182
13,	2.316	2.056
20,	2.394	1.409
27,	1.463	0.883
Nov. 3,	1.874	1.605
10,	1.652	2.399
17,	1.533	1.528
24,	3.283	2.085
Dec. 1,	6.421	3.527
8,	3.542	2.561
15,	3.607	3.962
22,	3.574	3.150
29,	3.082	3.017
1890.		
Jan. 5,	2.057	2.171
12,	1.840	1.782
19,	2.445	2.086
26,	1.664	2.054
Feb. 2,	1.611	1.506
9,	2.151	1.946
16,	2.261	2.618
23,	1.659	1.950
Mar. 2,	3.727	3.456
9,	2.542	2.774
1890. — Con.		
Mar. 16,	5.890	3.318
23,	6.978	3.627
30,	7.621	4.926
Apr. 6,	3.973	3.807
13,	4.218	5.206
20,	2.194	4.668
27,	1.793	3.105
May 4,	1.996	3.001
11,	2.790	4.233
18,	2.154	3.288
25,	1.538	2.833
June 1,	2.059	3.484
8,	1.218	2.428
15,	1.189	2.233
22,	0.743	1.740
29,	0.381	1.027
July 6,	0.213	0.822
13,	0.067	0.757
20,	0.067	0.508
27,	0.262	0.588
Aug. 3,	0.200	0.873
10,	0.105	0.467
17,	0.127	0.326
24,	0.241	0.479
31,	0.374	1.870
Sept. 7,	0.469	1.436
14,	0.731	1.213
21,	1.245	3.760
28,	0.427	1.715
Oct. 5,	1.186	1.232
12,	1.378	1.572
19,	2.599	2.392
26,	6.953	5.771
Nov. 2,	4.345	3.541
9,	2.209	2.257
16,	1.715	1.727
23,	2.059	2.578
30,	1.150	1.525
Dec. 7,	1.151	1.171
14,	0.956	1.221
21,	2.981	1.474
28,	1.360	1.865

SUGGESTIONS

AS TO THE

SELECTION OF SOURCES OF WATER SUPPLY.

By FREDERIC P. STEARNS,
ENGINEER OF THE BOARD.

SUGGESTIONS AS TO THE SELECTION OF SOURCES OF WATER SUPPLY.*

In selecting a source of water supply it is essential that all water should be rejected which is seriously polluted with domestic sewage. There are other waters not so polluted, as for instance those having a disagreeable taste and odor or drawn directly from swamps, which are manifestly unfit for drinking. A water may also be rejected by reason of its extreme hardness, which makes it unsuitable for washing purposes and for use in boilers. Among the waters which may be used there is a large difference in quality, and this in connection with the quantity and cost should receive careful consideration in making the selection.

Sources may be divided into two general classes, those in which the supply is taken from the ground, known as ground waters, and those obtained from lakes, ponds, streams and storage reservoirs, known as surface waters.

The prominent characteristic of ground water is freedom from color and organic matter (including microscopic organisms), while surface waters are frequently colored with vegetable matter derived from swamps, and almost always contain a greater or less number of microscopic or larger organisms, which, when abundant, frequently impart to the water a disagreeable taste and odor.

With regard to the question of quantity, sufficient surface water can be obtained for the largest cities, and the amount which can be obtained from a given water-shed can be estimated in advance with a large degree of accuracy. Ground water supplies, on the other hand, are much more limited in quantity, and the amount to be obtained from any given place cannot be as accurately predicted.

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* These suggestions are based mainly upon observations in Massachusetts, and, in some respects, will be inapplicable to other places where different conditions prevail.

As a whole we may say that when unpolluted ground water can be obtained in sufficient quantity from regions where the water does not dissolve much mineral matter and in this way become hard, it is very much to be preferred to surface water for the supply of a city or town.

With these general statements we will proceed to consider in greater detail the quantity and quality of water to be derived from surface and ground water sources, including among the ground waters those taken from wells and filter-galleries built beside streams and ponds, and deriving their water, in part, from these surface waters, by filtration.

The question of the *quality* of waters variously situated has been so fully treated in the special report of the Board, Part I., 1890, that the present article will give greater prominence to the *quantity* of water to be obtained under different circumstances.

Quantity of Surface Water.

All sources from which water is obtained depend for their supply upon the rain which falls upon the area from which the water can flow over the surface or under ground to the point whence it is taken for use. In a great majority of cases this area coincides with the superficial water-shed of the stream or pond utilized. We have, therefore, as very important factors affecting the quantity of water, the amount of the annual rainfall and the area of the water-shed.

The whole of the rain which falls upon a water-shed does not flow off into the streams, because much is lost by evaporation from the surface of the ground. The amount of this loss has been determined practically by comparing the quantity of water falling upon a given water-shed (as deduced from the depth of rainfall and the area of the water-shed) with the amount of water flowing off in the streams. Very valuable records of this character have been kept by the city of Boston for many years at Cochituate Lake, Sudbury River and Mystic Lake, and the results have been published in the annual reports of the Boston Water Board. From these we learn that the average percentage of rainfall collected from these three water-sheds is as follows: —

	Average Rainfall. Inches.	Average Rainfall Collected. Inches.	Per Cent. Collected.
Lake Cochituate (28 years' observations), ...	47.82	20.55	42.97
Sudbury River (16 years' observations), ...	45.80	22.67	49.50
Mystic Lake (13 years' observations), ...	44.11	20.22	45.84

In attempting to determine the quantity of water which can be made available for use from any given source, the above figures, representing the average results of many years' observations, have only a limited value, because there is a marked variation in the amount of rainfall in different years and a still greater difference in the amount of rainfall collected, the rule being that the percentage collected decreases with the amount of the annual rainfall; moreover, there is a vast difference in the amount of rainfall collected at different seasons of the year. In view of these differences it is obviously necessary to take into account the rainfall collected during dry periods of much less than a year's duration. This can be done by means of the records of the Boston Water Works above referred to. Of these the Sudbury River records are the most accurate and the most generally applicable to conditions existing at other places, and, on account of their value as a basis for water supply estimates, they are reproduced from the reports of the Boston Water Board in the following table. The rainfall collected is also shown graphically upon the diagram opposite page 340.

Rainfall Received and Collected on the Sudbury River Water-shed.

MONTH.	1875.			1876.			1877.			1878.			1879.			1880.		
	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.
	Inches.	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*	
January,	2.42	0.184	7.6	1.83	1.147	62.7	3.216	1.174	36.5	5.632	3.228	57.3	2.478	1.249	50.4	3.566	2.000	56.02
February,	3.15	2.411	76.5	4.21	2.282	54.2	0.739	1.529	206.9	5.973	3.972	66.5	3.562	2.756	77.4	3.980	2.982	74.92
March,	3.74	2.862	76.5	7.43	7.911	106.5	8.357	8.586	102.7	4.689	6.256	133.4	5.140	4.156	80.9	3.315	2.451	73.93
April,	3.23	5.263	162.9	4.197	5.683	135.4	3.435	4.132	120.3	5.790	2.807	48.5	4.716	5.379	114.1	3.105	2.017	64.97
May,	3.56	2.119	59.5	2.763	2.031	73.5	3.702	2.482	67.0	0.956	2.487	260.2	1.579	1.987	125.8	1.836	0.917	49.95
June,	6.24	1.501	24.0	2.040	0.383	18.8	2.425	1.031	42.5	3.884	0.873	22.5	3.789	0.713	18.8	2.138	0.303	14.16
July,	3.57	0.573	16.0	9.134	0.326	3.6	2.951	0.360	12.2	2.971	0.229	7.7	3.933	0.281	7.1	6.273	0.315	5.02
August,	5.53	0.706	12.8	1.720	0.723	42.0	3.682	0.216	5.9	6.937	0.848	12.2	6.509	0.705	10.8	4.008	0.212	5.29
September,	3.43	0.358	10.4	4.614	0.318	6.9	0.323	0.103	31.9	1.291	0.277	21.5	1.878	0.243	12.9	1.603	0.138	8.64
October,	4.85	1.152	23.8	2.241	0.417	18.6	8.515	1.127	13.2	6.417	0.921	14.3	0.809	0.126	15.6	3.740	0.181	4.85
November,	4.83	2.248	46.5	5.764	1.878	32.6	5.803	2.447	42.2	7.024	2.922	41.6	2.682	0.355	13.2	1.785	0.354	19.85
December,	0.94	1.041	110.7	3.620	0.809	22.3	0.870	2.300	264.4	6.367	5.667	89.0	4.344	0.825	19.0	2.828	0.312	11.05
TOTALS AND AVERAGES,	45.49	20.418	44.9	49.563	23.908	48.2	44.018	25.487	57.9	57.931	30.487	52.6	41.419	18.775	45.3	38.177	12.182	31.91

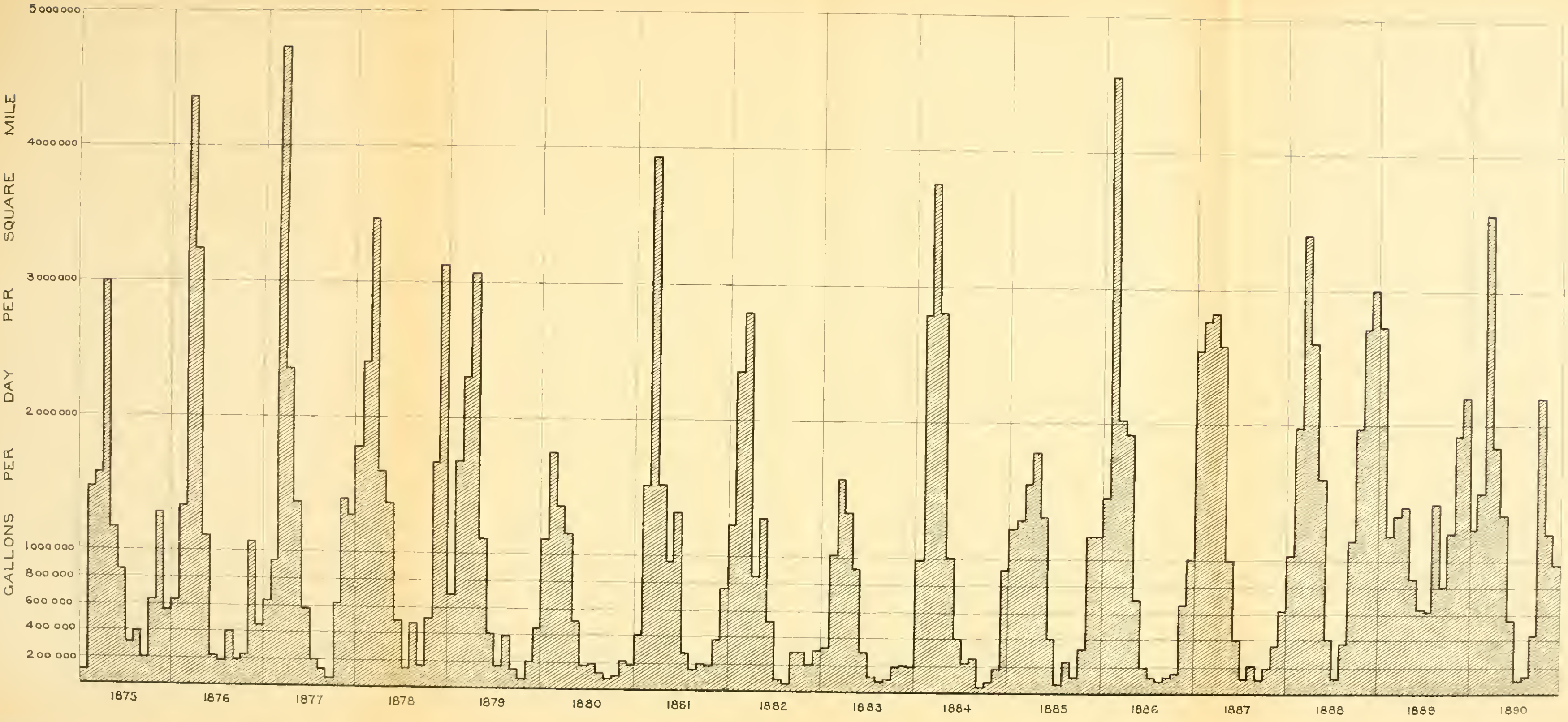
Rainfall Received and Collected on the Sudbury River Water-shed — Continued.

Month.	1881.			1882.			1883.			1884.			1885.			1886.		
	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall. Collected.	Per Cent. Collected.
	Inches.	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*	
January, ...	5.558	0.740	13.31	5.951	2.213	37.19	2.81	0.597	21.25	5.085	1.775	34.91	4.71	2.203	46.76	6.365	2.606	40.94
February, ...	4.646	2.491	53.62	4.546	3.872	85.18	3.865	1.664	43.05	6.545	4.742	72.45	3.865	2.182	56.44	6.28	7.734	123.16
March, ...	5.730	7.142	124.64	2.649	5.064	191.16	1.78	2.873	161.42	4.72	6.752	143.06	1.07	2.805	262.14	3.61	3.672	101.72
April, ...	2.000	2.669	133.44	1.824	1.497	82.09	1.845	2.330	126.27	4.405	4.925	111.82	3.605	3.133	86.91	2.225	3.361	151.06
May, ...	3.511	1.721	49.03	5.066	2.304	45.48	4.185	1.673	39.96	3.47	1.838	52.97	3.485	2.383	68.38	2.995	1.285	42.90
June, ...	5.395	2.309	42.80	1.664	0.913	54.87	2.40	0.518	21.58	3.445	0.719	20.86	2.865	0.735	25.66	1.465	0.350	23.93
July, ...	2.350	0.493	20.98	1.769	0.154	8.70	2.68	0.206	7.68	3.665	0.399	10.89	1.425	0.111	7.77	3.265	0.206	6.32
August, ...	1.358	0.264	19.45	1.667	0.099	5.91	0.735	0.140	19.06	4.65	0.458	9.85	7.185	0.429	5.97	4.10	0.168	4.09
September, ...	2.617	0.340	13.01	8.741	0.529	6.05	1.52	0.157	10.36	0.855	0.076	8.87	1.425	0.209	14.66	2.905	0.203	6.98
October, ...	2.955	0.331	11.20	2.074	0.534	25.74	5.60	0.331	5.92	2.48	0.148	5.98	5.095	0.599	11.75	3.235	0.260	8.04
November, ...	4.091	0.682	16.66	1.147	0.362	31.51	1.81	0.354	19.52	2.645	0.302	11.44	6.095	2.033	33.35	4.645	1.161	25.01
December, ...	3.958	1.383	34.93	2.296	0.561	24.45	3.55	0.345	9.72	5.17	1.650	31.91	2.72	2.094	76.99	4.975	1.819	36.56
TOTALS AND AVERAGES, .	44.169	20.565	46.56	39.394	18.102	45.95	32.78	11.188	34.13	47.135	23.784	50.46	43.545	18.916	43.44	46.065	22.825	49.55

Rainfall Received and Collected on the Sudbury River Water-shed — Concluded.

Month.	1887.			1888.			1889.			1890.			Mean for 16 Years. 1875-1890.		
	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.	Rainfall.	Rainfall Collected.	Per Cent. Collected.
	Inches.	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*	
January,	5.20	4.619	88.82	4.15	1.878	45.26	5.37	4.963	92.42	2.53	2.237	88.43	4.179	2.051	49.08
February,	4.78	4.558	95.35	3.685	3.255	88.32	1.655	1.926	116.39	3.505	2.464	70.29	4.062	3.176	78.19
March,	4.90	5.116	104.40	6.02	5.775	95.93	2.365	2.388	100.95	7.735	6.498	84.01	4.578	5.019	109.63
April,	4.265	4.522	106.03	2.425	4.566	188.30	3.41	2.434	71.37	2.645	3.236	122.35	3.320	3.622	109.10
May,	1.165	1.799	154.46	4.825	2.912	60.35	2.945	1.569	53.27	5.21	2.437	46.78	3.203	1.996	62.32
June,	2.65	0.714	26.93	2.535	0.728	28.70	2.80	1.128	40.27	2.03	0.980	48.27	2.985	0.869	29.11
July,	3.76	0.204	5.45	1.405	0.209	14.90	8.94	1.130	12.64	2.46	0.192	7.78	3.784	0.337	8.91
August,	5.28	0.382	7.24	6.225	0.677	10.87	4.175	2.554	61.18	3.865	0.235	6.08	4.227	0.552	13.06
September,	1.32	0.191	14.52	8.585	1.994	23.22	4.605	1.422	30.87	6.00	0.790	13.16	3.232	0.459	14.20
October,	2.835	0.339	11.96	4.99	3.566	71.45	4.255	2.194	51.57	10.51	4.053	38.56	4.413	1.017	23.05
November,	2.67	0.636	23.83	7.225	4.761	65.90	6.29	3.351	53.27	1.20	2.097	174.72	4.107	1.621	39.47
December,	3.88	1.147	29.58	5.395	5.428	100.60	3.14	3.997	127.30	5.31	1.779	33.49	3.710	1.947	52.48
TOTALS AND AVERAGES,	42.705	24.227	56.73	57.465	35.749	62.21	49.95	29.056	58.17	53.000	26.998	50.94	45.800	22.667	49.49

DIAGRAM SHOWING RAINFALL COLLECTED ON THE SUDBURY RIVER WATERSHED FROM 1875 TO 1890.



The most prominent feature of the table and diagram is the immense difference in the amount of water collected in the spring and in the summer; but the difference between the flow of different years is also very great. The dryest years were 1880 and 1883, in each of which there was a severe drought during the last seven months, and even during the spring of each of these years the amount collected was much less than in other years. The summer of 1889 was in marked contrast with all of the others, the flow being unprecedentedly high.

As has already been indicated it is necessary in estimating the capacity of sources of water supply to take into account the dryest periods which have occurred, and which consequently may recur; and for this reason it is the minimums recorded in the foregoing table which have the most value. These for periods varying in duration from one month to sixteen years have been carefully selected from the table, and are presented in more convenient form in the one which follows: —

Table showing the Average Daily Flow from the Sudbury River Water-shed for Different Periods, varying from One Month to Sixteen Years, selecting in Each Case the Dryest Period of the Given Duration.

LENGTH OF PERIOD.	Dates.	AVERAGE DAILY FLOW OF WATER-SHED.		
		Gallons per Day per Square Mile.	Gallons per Day per Acre.	Cubic Feet per Second per Square Mile.
1 month, ...	September, 1884, . . .	44,000	69	.068
2 months, . . .	Sept. 1, 1884, to Oct. 31, 1884,	64,000	100	.099
3 months, . . .	July 1, 1883, to Sept. 30, 1883,	95,000	148	.147
4 months, . . .	July 1, 1883, to Oct. 31, 1883,	118,000	184	.183
5 months, . . .	June 1, 1880, to Oct. 31, 1880,	131,000	205	.203
6 months, . . .	June 1, 1880, to Nov. 30, 1880,	143,000	223	.221
7 months, . . .	June 1, 1880, to Dec. 31, 1880,	147,000	230	.227
8 months, . . .	June 1, 1880, to Jan. 31, 1881,	181,000	283	.280
9 months, . . .	May 1, 1880, to Jan. 31, 1881,	219,000	342	.339
10 months, . . .	April 1, 1880, to Jan. 31, 1881,	312,000	487	.483
11 months, . . .	Mar. 1, 1880, to Jan. 31, 1881,	409,000	639	.633
1 year, ...	Mar. 1, 1880, to Feb. 28, 1881,	497,000	777	.769
2 years, ...	Feb. 1, 1882, to Jan. 31, 1884,	687,000	1,073	1.063
3 years, ...	Mar. 1, 1880, to Feb. 28, 1883,	764,000	1,194	1.182
4 years, ...	Feb. 1, 1880, to Jan. 31, 1884,	735,000	1,148	1.137
5 years, ...	Jan. 1, 1879, to Dec. 31, 1883,	769,000	1,202	1.190
6 years, ...	Oct. 1, 1879, to Sept. 30, 1885,	803,000	1,255	1.242
7 years, ...	Jan. 1, 1879, to Dec. 31, 1885,	839,000	1,311	1.298
8 years, ...	Jan. 1, 1879, to Dec. 31, 1886,	870,000	1,359	1.346
9 years, ...	Jan. 1, 1879, to Dec. 31, 1887,	902,000	1,409	1.396
10 years, ...	April 1, 1878, to Mar. 31, 1888,	944,000	1,475	1.461
11 years, ...	Jan. 1, 1875, to Dec. 31, 1885,	968,000	1,512	1.498
12 years, ...	Jan. 1, 1875, to Dec. 31, 1886,	978,000	1,528	1.513
13 years, ...	Jan. 1, 1875, to Dec. 31, 1887,	991,000	1,548	1.533
14 years, ...	Jan. 1, 1875, to Dec. 31, 1888,	1,042,000	1,628	1.612
15 years, ...	Jan. 1, 1875, to Dec. 31, 1889,	1,065,000	1,664	1.648
16 years, ...	Jan. 1, 1875, to Dec. 31, 1890,	1,079,000	1,686	1.670

With such a vast difference in the average daily flow during the dryest month and the dryest year, and also in the flow during the dryest year and a long series of years, it is obvious that the quantity of water which can be made available from a given water-shed depends very much upon the amount which can be stored in seasons when water is abundant for use during seasons of drought.

It is feasible to deduce from the Sudbury River records a table which will show directly the amount of storage necessary to make available different quantities of water per day from each square mile of water-shed,* where the conditions are similar to those which exist at Sudbury River. A table of this character is given below, which, in addition to the amount of storage required, gives the length of time the reservoir would have been below high water mark during the dryest period of the given duration, and the date when the water in the reservoir would have reached its lowest level.

Table showing the Amount of Storage required to make Available Different Daily Volumes of Water per Square Mile of Water-shed,† based upon the Records of the Flow of Sudbury River from 1875 to 1890, inclusive.

Daily Volume per Square Mile. Gallons.	Storage required per Square Mile to prevent a Deficiency in the Season of Greatest Drought when the Daily Consumption of Water is as Indicated in the First Column. Gallons.	DATES WHEN GREATEST DRAUGHT FROM RESERVOIR WOULD HAVE OCCURRED DURING THE PERIOD. 1875-1890.			Length of Time Reservoir would have been below High Water Mark.
		Beginning of Draught upon Reservoir.	Lowest Point Reached.	Reservoir Full Again.	
100,000	2,200,000	Sept., 1884,	Oct., 1884,	Nov., 1884,	3 months.
150,000	5,300,000	Sept., 1884,	Oct., 1884,	Dec., 1884,	4 months.
200,000	11,000,000	June, 1880,	Dec., 1880,	Feb., 1881,	9 months.
250,000	22,000,000	June, 1880,	Dec., 1880,	Feb., 1881,	9 months.
300,000	33,000,000	June, 1880,	Dec., 1880,	Feb., 1881,	9 months.
400,000	54,000,000	June, 1880,	Dec., 1880,	Mar., 1881,	10 months.
500,000	78,000,000	June, 1880,	Jan., 1881,	Mar., 1881,	10 months.
600,000	105,000,000	May, 1880,	Jan., 1881,	Mar., 1881,	11 months.
700,000	156,000,000	June, 1882,	Dec., 1883,	Mar., 1884,	1 year 10 months.
800,000	214,000,000	June, 1882,	Dec., 1883,	April, 1884,	1 year 11 months.
900,000	373,000,000	June, 1879,	Dec., 1883,	May, 1887,	8 years.
1,000,000	540,000,000	June, 1879,	Dec., 1883,	Mar., 1890,	10 years 10 mos.
1,024,000	596,000,000	June, 1879,	Oct., 1885,	May, 1890,	11 years.

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* The area of the Sudbury River water-shed, as used for making up the records, includes both land and water surfaces.

† Including water surfaces amounting to 2.31 per cent. of the land surface.

Having deduced from the Sudbury River records the facts given in the last table, we have next to consider to what extent they are applicable to other water-sheds. It may be said in a general way that the dry weather flow of different streams per square mile of water-shed, without artificial storage, is liable to differ greatly; but that the total yearly flow does not vary nearly as much. In many cases it will be found, by applying the Sudbury River records directly, that there is so great a difference between the estimated yield and the amount of water required that any further refinement is unnecessary. In other cases it is necessary to take into account everything which may affect the application of these records. The chief causes of variation in the yield of different water-sheds per square mile, after taking into account the influence of storage, are: the amount of rainfall and its distribution throughout the year, the area of water surfaces, the character of the surface of the ground as regards topography and material, and the size of the water-shed. There is also another feature which frequently requires consideration, particularly with small and steep water-sheds; namely, the loss of water by leakage past dams and by filtration through the ground to a lower level.

The conditions which existed upon the Sudbury River watershed during the time included in the records were as follows: The area of the water-shed from which the flow was measured was 77.764 square miles until the end of 1878, then 78.238 square miles until the end of 1880, and after that time 75.199 square miles. These areas include all water surfaces. From the beginning of the observations until the end of 1878, the water surfaces consisted of Farm Pond, Whitehall Pond (which was flowed in winter and drawn down in summer), several millponds, and the various streams. The area of these combined water surfaces was equal to 1.02 per cent. of the land surfaces. The construction of artificial storage reservoirs has since increased the area of water surfaces. Three reservoirs were completed and filled in 1879, making the total area of water surfaces after this date, until 1886, 2.31 per cent. of the land surfaces. In 1886, Reservoir No. 4 was added, increasing the per cent. of water surfaces to 2.92. The dryest periods occurred between the years 1879 and 1886, and it may therefore be assumed that the water surfaces of Sudbury River which had the most effect upon the present records were 2.31 per cent. of the land area.

The flow of the river past the lowest dam has been greatly modified by the use of the artificial reservoirs; but this does not appear in the records, because the amount flowing past the dam is corrected by the amount added to or drawn from storage. The object in making these corrections has been to eliminate the effect of the reservoirs and to present in the records the natural flow of the stream modified only by such storage as is furnished by ordinary mill-ponds and by Whitehall Pond. It cannot, however, be said that the effect of the reservoirs is wholly eliminated, because the evaporation from the increased water surfaces is not taken into account; and the dry weather flows recorded are consequently less than they would be if these reservoirs did not exist.

The average annual rainfall upon the Sudbury River watershed is nearly the same as that in other parts of the State, so that it is not often necessary to take into account any difference of this kind.

The water-shed of the Sudbury River contains many hills with steep slopes, some of which are used for pasturage and others are covered with a small growth of wood. The valleys, as a rule, are not steep, and there are extensive areas of swampy land, generally covered with a growth of brush and trees. The hills are, for the most part, of rather impervious clayey material, containing boulders, while the flat land is sandy and in some cases gravelly.

The special characteristics of the Sudbury River water-shed have thus been described in detail, so that in applying the results to other water-sheds such modifications could be made as would be rendered necessary by the difference in conditions.

In this paper further consideration will be given only to the effect of a varying percentage of water surfaces upon the yield of water-sheds, and to the flow during short periods of drought.

With regard to the effect of water surfaces it has been a common practice to leave them out of consideration in estimating the area of a water-shed, upon the assumption that the evaporation from water surfaces offsets the rainfall upon them. The Sudbury River records, however, were not made upon this basis, and they are therefore strictly applicable only to water-sheds which have the same proportion of water surfaces, unless a correction is made for evaporation.

A table will be presented subsequently which gives the yield per square mile of land surface, when in addition to the land there is a varying percentage of water surfaces. Before presenting this table, however, it may be well to indicate in a general way the relation of the evaporation from water surfaces to the rainfall upon them.

For determining the amount of evaporation, the most valuable information is to be obtained from the paper* presented by Desmond FitzGerald, C.E., to the American Society of Civil Engineers, based upon experiments made upon the Boston Water Works, chiefly at Chestnut Hill Reservoir, Boston. In his paper, as the result of several years' experiments, a mean evaporation for each month of the year is given. By comparing this with the mean rainfall for each month, as given at the end of the table on page 340, we can obtain the relation between evaporation and rainfall in an ordinary year; and as the evaporation does not vary very much from year to year, we can also obtain approximately the relation between the evaporation and rainfall in a dry year, by comparing the average evaporation with the rainfall in a dry year like 1883.

The results of these comparisons are shown by the following table and diagram: —

Table showing Relation of Evaporation to Rainfall.

NOTE. + indicates excess of rainfall; — indicates deficiency.

MONTH.	AVERAGE YEAR.			YEAR OF LOW RAINFALL.		
	Rainfall. Inches.	Evaporation. Inches.	Excess or Deficiency of Rainfall. Inches.	Rainfall. Inches.	Evaporation. Inches.	Excess or Deficiency of Rainfall. Inches.
January,	4.18	0.98	+3.20	2.81	0.98	+1.83
February,	4.06	1.01	+3.05	3.86	1.01	+2.85
March,	4.58	1.45	+3.13	1.78	1.45	+0.33
April,	3.32	2.39	+0.93	1.85	2.39	—0.54
May,	3.20	3.82	—0.62	4.18	3.82	+0.36
June,	2.99	5.34	—2.25	2.40	5.34	—2.94
July,	3.78	6.21	—2.43	2.68	6.21	—3.53
August,	4.23	5.97	—1.74	0.74	5.97	—5.23
September,	3.23	4.86	—1.63	1.52	4.86	—3.34
October,	4.41	3.47	+0.94	5.60	3.47	+2.13
November,	4.11	2.24	+1.87	1.81	2.24	—0.43
December,	3.71	1.38	+2.33	3.55	1.38	+2.17
	45.80	39.12	+6.68	32.78	39.12	—6.34

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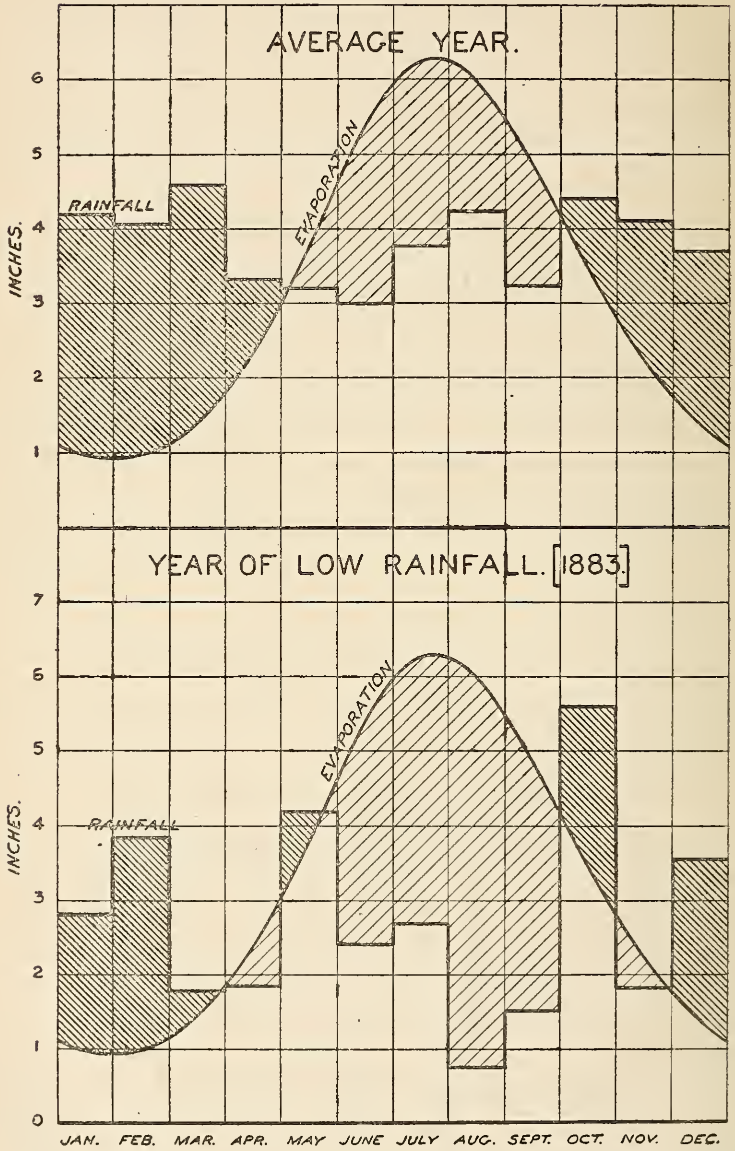
* Evaporation, by Desmond FitzGerald, C.E., Transactions of the American Society of Civil Engineers, Vol. XV., 1886, p. 581.

Diagram showing the Relation of Evaporation to Rainfall.



NOTE. — The curved lines show the average evaporation in inches per month, and the horizontal lines the rainfall, also in inches, per month. The finer hatching indicates the excess of rainfall, and the coarser hatching the excess of evaporation.

It will be seen from the facts presented that the monthly rainfall varies much less during the year than the evaporation; also that in an average year the rainfall is 6.68 inches greater than the evaporation. The average year may be divided into two periods, one extending from May to September, inclusive, in which the evaporation is 8.77 inches greater than the rainfall; and the other extending from October to April, inclusive, in which the rainfall exceeds the evaporation by 15.45 inches.

In the year of low rainfall the evaporation was 6.34 inches greater than the rainfall. During the warmer months, from April to September, inclusive, the excess of evaporation was 15.22 inches, and during the other six months the rainfall was 8.88 inches in excess of the evaporation. These figures indicate that a pond will not lower by evaporation in a dry summer more than about fifteen inches, even if it receives no water from its water-shed.

In order to present in the most convenient form the yield of water-sheds per square mile, the following table has been prepared, which gives the quantity of water which may be made available per square mile of water-shed (estimating land surfaces only), with varying amounts of storage and a varying percentage of water surfaces. In preparing the table the records of the flow of Sudbury River and of the rainfall upon the Sudbury River water-shed from 1875 to 1890, inclusive, as given in the table on pages 338–340, have been used; also the records of evaporation from water surfaces from observations made chiefly at Chestnut Hill Reservoir during the years 1876 to 1880 and 1885 to 1887. For other years, when the evaporation was not measured, the average evaporation, as given in the table on page 345, has been used. The flow per square mile is in all cases the smallest recorded after taking into account the evaporation from water surfaces.

Table showing the Amount of Storage required to make Available Different Daily Volumes of Water per Square Mile of Water-shed (estimating Land Surfaces only), corrected for the Effect of Evaporation and Rainfall on Varying Percentages of Water Surfaces, not included in estimating the Area of the Water-shed.

Daily Volume in Gallons per Square Mile of Land Surface.	Storage required in Gallons per Square Mile of Land Surface to prevent a Deficiency in the Season of Greatest Drought when the Daily Consumption is as indicated in the First Column, with the following Percentages of Water Surfaces.				
	0 Per Cent.	3 Per Cent.	6 Per Cent.	10 Per Cent.	25 Per Cent.
100,000	556,000	3,000,000	8,800,000	-	-
150,000	3,400,000	7,100,000	13,400,000	-	-
200,000	9,400,000	11,700,000	18,000,000	-	-
250,000	19,000,000	22,200,000	25,400,000	-	-
300,000	29,800,000	33,000,000	36,100,000	-	-
400,000	52,000,000	54,400,000	57,500,000	-	-
500,000	76,500,000	77,300,000	80,300,000	-	-
600,000	102,000,000	104,600,000	107,100,000	112,800,000	-
700,000	144,400,000	153,000,000	161,600,000	170,700,000	215,900,000
800,000	202,300,000	210,900,000	219,500,000	228,600,000	273,800,000
900,000	346,200,000	349,200,000	352,200,000	353,900,000	381,600,000
1,000,000	514,600,000	516,700,000	519,700,000	523,600,000	532,200,000

The table shows that a daily yield of 1,000,000 gallons per square mile of land surface can be made available when there is a very large amount of storage, such as may be found in some instances where a large pond is fed by a very small water-shed. To obtain this quantity, however, would require the reservoir to be below high water mark for eleven years; and during a considerable portion of the time the water would not rise nearly to high water mark, even in the spring. In practice this would be objectionable as it would permit the growth of weeds, grasses and bushes on the exposed shores of the reservoir. Taking everything into account it may be said that the greatest amount which can be made practically available from a square mile of water-shed does not exceed 900,000 gallons per day, and the cases are very rare in which more than 600,000 gallons per square mile per day can be made available when it is necessary to store the water in artificial reservoirs.

As a matter of theoretical interest only, it may be said that to make available the average yield of the Sudbury River water-shed for the entire sixteen years (1,079,000 gallons per day per square mile) would require a storage capacity of not less than 725,000,000 gallons per square mile. This is about six times the amount of storage which it is now considered feasible to provide on this water-shed.

The amount of water which can be made available from a given water-shed will not always depend upon the quantity of water which can be stored, because considerations of quality require that the levels of the reservoir should not be made to fluctuate too much, and that the reservoir should not be drawn below high-water mark for too long a time.

The diagram given opposite the following page has been prepared from the Sudbury River records to show the fluctuations of a reservoir from which various quantities of water — namely, 400,000, 600,000, 800,000 and 900,000 gallons per day per square mile — are drawn. The dotted lines marked "overflow" represent the full reservoir. Where the full lines fall below the dotted lines a draught upon the reservoir is indicated, the amount of which in gallons of storage per square mile is shown by the scale given on the diagram. It will be seen that a consumption of 800,000 or 900,000 gallons per day per square mile causes a reservoir to be drawn below high-water mark for many years at a time, which could hardly be permitted except in the case of a natural pond with gravelly shores.

The application in actual practice of the table on the opposite page may be better understood by giving an example. Let us assume that it is desired to know the yield of a pond having an area of .15 of a square mile and an available storage capacity of 225,000,000 gallons, which has draining into it 1.5 square miles of land surface. The amount of storage in this case would be equivalent to 150,000,000 gallons per square mile of land surface, and the water surface would equal ten per cent. of the land surface. By looking in the column of the table headed ten per cent. it will be seen that a storage of 150,000,000 gallons per square mile corresponds to a daily volume of between 600,000 and 700,000 gallons per square mile, or more exactly by proportion to 660,000 gallons, equal to 990,000 gallons daily for the whole water-shed. The results obtained by this method will in some cases be practically correct. In other cases it will be necessary to take account of local conditions, prominent among which may be leakage past a dam or filtration through the ground to lower levels; and the application of judgment will often be necessary to determine whether the water-shed under consideration will yield the same or a greater or less amount per square mile than that of the Sudbury River.

The only point remaining to be considered with regard to the quantity of surface water relates to the flow from water-sheds during short periods of extreme drought. The flow during such periods is chiefly of importance when it is desired to know the minimum flow of streams on which little or no storage can be obtained. On such water-sheds the water surfaces are generally insignificant, so that the Sudbury River records are not applicable unless they are corrected for evaporation. It is well known that the natural dry weather flow of streams per square mile depends much upon the *extent* of the water-shed; because it is frequently observed that streams draining but a small area dry up in summer, while those draining large areas continue to flow, though with a greatly reduced volume. There is also a large variation in the dry weather flow from water-sheds of the same size due to the amount of water stored in the ground and subsequently coming out in the form of springs. The records of the natural flow of streams in a very dry period are very meagre. The lowest flow of the Sudbury River occurred during the month of September, 1884, and averaged only 44,000 gallons daily per square mile of water-shed. Correcting for the excess of the evaporation from water surfaces over the rainfall upon them, we obtain 97,000 * gallons per square mile as the amount that the flow would have been if there had been no water surfaces. The next lowest monthly record was in September, 1877, 60,000 gallons per square mile. At this date the reservoirs had not been constructed and the area of water surfaces to be corrected for evaporation was smaller. Making the correction we have as the flow per square mile 82,000 gallons per day.

In the report of the Water Commissioners of the Pittsfield Fire District, dated April 1, 1887, it is stated that on Sept. 10, 1886, at the end of a somewhat extended drought, it was

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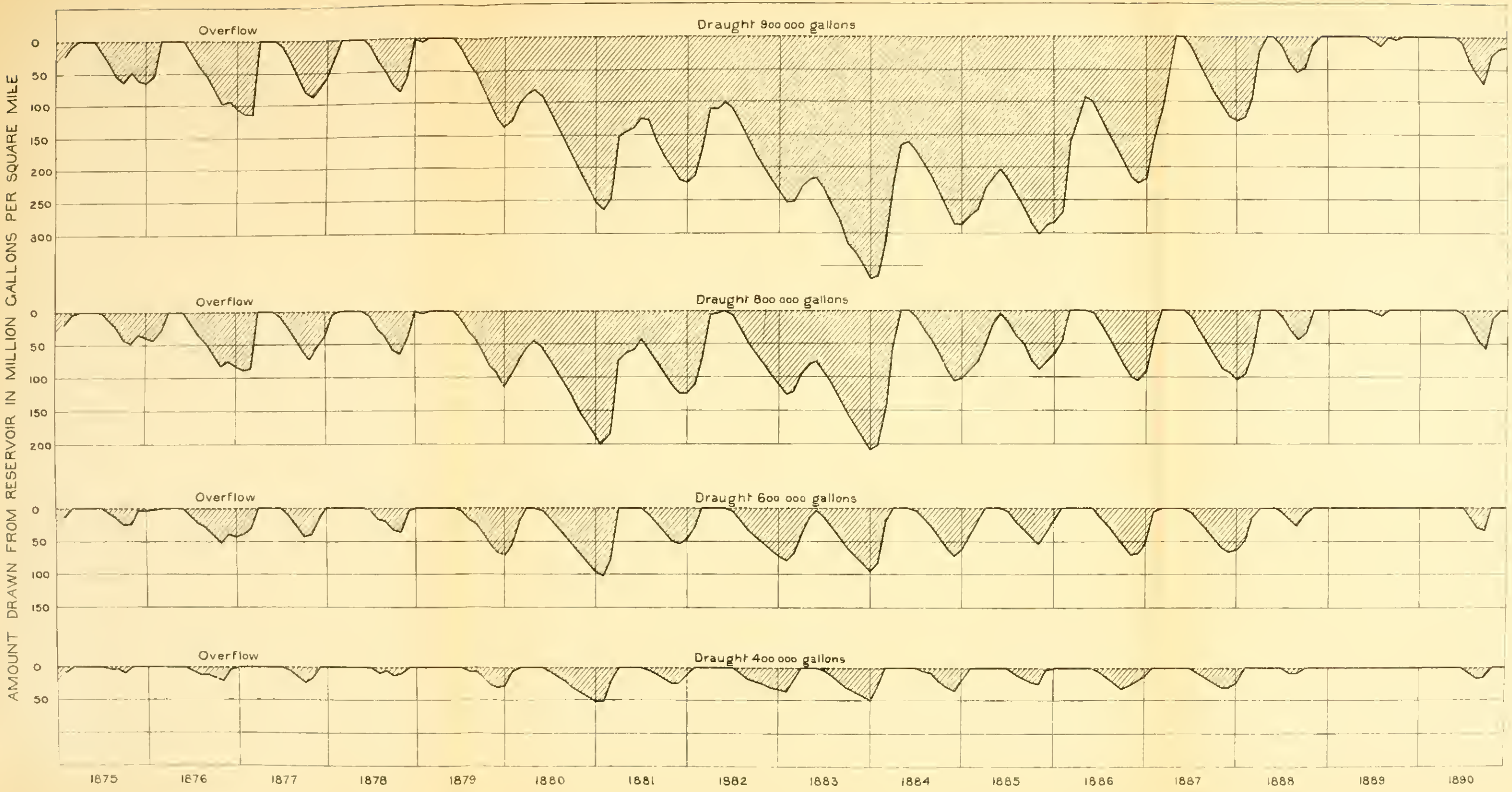
* This quantity is somewhat larger than it should be as no account is taken of the water which came from the ground adjoining the reservoirs as they were being drawn down to supply the city.

DIAGRAM SHOWING THE FLUCTUATIONS OF A RESERVOIR CAUSED BY A DAILY DRAUGHT OF 400,000, 600,000, 800,000, AND 900,000 GALLONS PER DAY PER SQUARE MILE OF WATERSHED



found by a careful measurement that 446,000 gallons were flowing daily in Sackett Brook and in Ashley Brook below the Ashley Reservoir, at a time when no water was overflowing from this reservoir. The area from which this water flowed was found by a measurement from the topographical map of the State to be 5.3 square miles; consequently the flow equals 84,000 gallons per square mile. This drainage area is mountainous, and contains no water surfaces except the streams.

In the report of the Board of Water Commissioners of Northampton for the year ending Feb. 1, 1883, a measurement of Roberts' Meadow Brook in August, 1882, is recorded. The volume, when the stream was at its lowest point, was 450,000 gallons in twenty-four hours. The area of the water-shed is 10.6 square miles; hence the flow per square mile amounted to 42,000 gallons per day. This water-shed has steep slopes, and contains no ponds or reservoirs of any importance.

On Aug. 8, 1890, Beaver Dam Brook, one of the feeders of Lake Cochituate, was measured by the engineers of the State Board of Health. The volume of water flowing was found to be 221,000 gallons per day. The measurement was made at the point where the brook first crosses the road between Natick and South Framingham. The area of the water-shed of the brook above this point, as taken from the topographical map of the State, is 5.82 square miles, making the daily flow per square mile 38,000 gallons. This water-shed contains Waushakum Pond, which has an area of 87 acres, and a very large area of meadow and swampy land.

It should be remarked with reference to the figures which have been given that the Sudbury River records represent the average flow for a month, while the other measurements represent the flow at one time only. On the other hand the Sudbury River measurements represent the dryest periods occurring in sixteen years, while the other measurements, although taken at times of very low flow, do not probably represent the dryest periods which occurred.

Judging from the few measurements which are available it seems fair to infer that the minimum flow from a square mile of water-shed without storage will not, under favorable conditions, exceed 80,000 gallons daily; and that under conditions frequently met with the flow may not be more than half of this amount; or with very small water-sheds it may be nothing at all, as in the case already cited of streams which run dry in summer. These statements do not, however, apply to the larger streams, such as the Connecticut, Merrimack and Chicopee rivers, which have a larger minimum flow.

Quantity of Ground Water.

It has already been stated that ground water supplies are much more limited as regards quantity than surface waters, and that the amount to be obtained at any given place cannot be as accurately predicted. There are, however, many examples in this State which show that the towns and smaller cities can obtain a sufficient supply of ground water where the local conditions are favorable; for instance, the city of Newton, with a population in 1890 of 24,379, obtains a ground water supply, and has recently been extending its works with a view to supplying a much larger population.

The statement that the quantity of ground water cannot be as accurately predicted as the quantity of surface water should not lead to the inference that the quantity of ground water to be obtained from any given source is chiefly a matter of guesswork, because it is feasible in most cases as a result of experience and calculation to determine with a moderate degree of accuracy the quantity of ground water which can be obtained from a given source.

In the case of ground waters as in the case of surface waters the supply is dependent upon the rainfall. It may be the rain which falls in the vicinity of the source and filters directly through the ground to it, or it may be that which finds its way into the streams and then filters through the bottom of the stream into the ground near the source from which the supply is taken; but it rarely happens that the supply comes from the rain which falls far outside of the direct water-shed of the source or of the stream near it.

In a large majority of cases ground water supplies are taken from large wells, tubular wells, filter-galleries or filter-basins situated in the low land adjacent to some large stream or pond. There are many instances, however, in which the supply is taken from a locality where no water comes by filtration from a stream or pond, and the whole supply is consequently rain water which filters into and through the ground to the point from which the water is taken. These two classes of ground waters require a somewhat different consideration; and the latter, in which a supply is taken from what may be called the direct water-shed of the well,* will be considered first.

In this case the conditions are in some respects similar to those which obtain in the case of surface water supplies; that is, the size of the water-shed, the proportion of the rainfall which will filter into the ground, and the amount of available storage in the interstices of the ground in the vicinity of the well are important factors; and there is in addition a factor which does not appear as prominently in the case of surface water supplies, namely, the porosity of the ground.

Statistics regarding the proportion of the rainfall which will filter into the ground are very few, but it is obvious that much less will enter the ground where the surface is sloping and nearly impervious than where it is flat and porous. Probably the most favorable water-shed that can be obtained is one which is generally level and gravelly and contains numerous depressions having no outlet, so that all the water from the rainfall which is not lost by evaporation goes of necessity into the ground. Much of the water-shed of the Mansfield source of supply is of this character. Under these most favorable conditions it seems probable that the quantity of water which passes into the ground will not vary much from that which flows over the surface and underground from the same area of water-shed into a stream. We may, therefore, for the present, estimate that the quantity of water which can be collected from the water-shed of a ground water source will not in any case *exceed* the amount to be collected from an equal area of water-shed of a surface water source, and that generally it will be less by the amount which runs off over the surface.

There is a common tendency to over-estimate the quantity of water which can be obtained from the ground in a locality where nature has already provided a free flowing spring, or where flowing test wells have been driven; but estimates based upon the size of the water-shed draining toward the spring or well will often show how incorrect these estimates are.

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* For convenience the term "well" will be used to designate all kinds of constructions for obtaining water from the ground.

Although a sufficient water-shed is essential it is equally essential that the ground should be porous enough to permit the required quantity of water to flow from the ground into the well.

In many cases where the supply required is not very large sufficient information as to the porosity of the ground can be obtained by driving test wells and determining the character of the strata penetrated. Some additional information may also be obtained by pumping from these wells with a hand pump. In order to predict the quantity of water which will flow into a well, after the character of the material is known, it is necessary to depend upon the experience obtained from existing wells in similar situations. Some information bearing upon this subject is given in the table opposite page 358.

In cases where a larger supply is necessary, or where the results of the tests above mentioned are not sufficiently definite, it may become desirable to make a more complete test, which is generally done by driving a large number of test wells, connecting them all with a single suction pipe and pumping from them.

A test of this character is generally intended to show not only the porosity of the ground, but also to indicate the amount of storage which is available, and the distance from which the ground water may be drawn to the wells when the water in their vicinity is lowered by long-continued pumping in a dry time. Records are kept of the height of the ground water in the immediate vicinity of the test wells and for a considerable distance from them in all directions. For this purpose frequent observations are made of the level of the water in existing wells which may be affected by the pumping, and where these do not exist in sufficient number additional test wells are driven to give access to the ground water.

A test of this kind should be made during as dry a period as possible; but even then the quantity pumped is not necessarily the safe capacity of the source, and the test has its greatest value in the opportunity it affords the engineer of determining the storage capacity of the ground, and the extent of the area from which the rainfall may be expected to filter toward the well. With the information obtained by such a test made in the dryer portion of an ordinary year it is feasible to estimate with a moderate degree of accuracy the safe capacity of a source in a dry year. A test of this character, lasting three months, was made at Eaton's Meadows, Malden, in 1887–88, before constructing the permanent works at that place.

It is sometimes feasible in the case of a proposed ground water supply to determine whether the source is worthy of careful investigation by means of the table given on page 348 for determining the volume of surface water obtainable with different amounts of storage. If, for instance, it is desired to obtain a supply of 300,000 gallons per day, and the water-shed draining toward the proposed well is one square mile, we find that in the case of a surface water supply the storage, when there are no water surfaces, must be 29,800,000 gallons. If the supply is to be taken from the ground it seems fair to assume that at least an equal amount of storage will be required; and the question to be considered relates to the probability of obtaining this amount of available storage, which is equivalent to the contents of a pond having an area of ten acres and a depth of nine feet. Porous gravel or sand when saturated contains in the neighborhood of thirty-five per cent. of water, but of this a portion remains after the ground is drained, so that only about twenty-five per cent. of the whole mass will run out when the water table is lowered. Therefore, in order to obtain 300,000 gallons daily from a square mile during the dryest period, it is necessary to have storage equivalent to that furnished by forty acres of porous gravel in which the water table can be lowered nine feet.. A superficial examination of the ground may show whether it is probable that this amount of storage can be obtained, and in this way indicate whether it is desirable to make further investigations.

In the case of wells located near a large stream or pond there is always a direct water-shed, the yield from which is to be obtained by the methods already indicated; but if this does not supply a sufficient quantity of water a greater or less amount will also filter from the stream or pond as soon as the adjacent ground water is lowered below the level of the surface water. That much water may come from a stream or pond and still have the characteristics of ground water is definitely shown in the case of the filter-gallery near Horn Pond, in Woburn, where the pond contains an abnormal amount of chlorine, owing to the tannery drainage, which contains much salt; and the filter-gallery water also has an abnormal amount of chlorine which cannot be attributed to any other source than the pond.* There are many other instances in the State where there are strong indications that a large portion of the supply comes from the neighboring river or pond, showing that the Woburn case is not an exceptional one.

No definite figures have ever been obtained of the amount of water which will filter through river or pond bottoms, but it is known that they get silted up so that the amount of water which will pass through per square foot is small, and it is consequently necessary to have a large area of river or pond bottom in the vicinity of the ground water source to obtain a large amount of water by this kind of filtration.

With regard to the form of construction used it may be said that no one method is applicable to all cases. Where the material is coarse and porous within a short distance of the surface and the quantity of water required is not very large, a circular well covered to exclude the light is generally the best. In other instances, where the material for a long distance from the surface is impervious, but is underlaid with pervious material, it is impracticable to excavate a large well to the required depth, and it becomes necessary to sink tubular wells down to the porous stratum, which may sometimes be found overlying the solid rock. An instance of this kind is found at Malden where the average depth of the wells is sixty-five feet. There are also other instances in which driven wells are used to obtain water from a larger territory than would be influenced by a single large well.

Tubular wells may be connected by means of a large suction pipe directly with the pump, which is generally the cheaper form of construction, or they may be connected with excavated wells or filter-galleries, into which the water from the driven wells will flow.

Filter-galleries are built in some instances where it is desired to intercept the ground water from a greater extent of territory than will be influenced by a single well. They are in fact elongated wells, except that, in practice, on account of the cost, they are not usually sunk to as great a depth.

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* The normal chlorine of the region, as shown on the chlorine map contained in this report, is 0.33; the average chorines of the filter-gallery and pond for three and one-half years are, respectively, 2.20 and 2.57.

Filter-basins perform the same office in collecting water as wells and filter-galleries, but being uncovered, the water in them deteriorates, owing to the rapid growth of vegetable and animal forms which flourish in this kind of water when the light is not excluded. This form of construction should therefore be avoided.

There are many instances in which the main supply comes from wells and filter-galleries, but is increased by means of driven wells extending from them into porous strata at lower levels.

In addition to the ordinary driven wells already referred to, which are limited in depth to from thirty to ninety feet, and do not in any case penetrate the rock, attempts have been made in several parts of the State to obtain a large supply of water by sinking wells six or eight inches in diameter into the rock to a depth of several hundred or even several thousand feet. The result has been in nearly every case unsatisfactory, and in no way comparable with the results obtained from comparatively shallow wells in porous material.

The information heretofore published with regard to the quantity of water which can be obtained from wells and filter-galleries variously situated is very meagre. With a view of obtaining additional light upon this subject a circular has been sent to the places in this State having a ground water supply asking for the following information: —

1. Name of city or town.
2. Population, 1890.
3. Description of works for collecting water.
4. Character of ground in which works were built.
5. Information regarding capacity of source: —
    (*a.*) Pumping record by months since 1886.
    (*b.*) Greatest amount pumped in any week.
    (*c.*) Greatest amount pumped in any day, and the amount that the water in the well was lowered by such pumping.
    (*d.*) Special tests indicating the capacity of the source.
    (*e.*) Estimate of the capacity of the source in a dry season
    (*f.*) Estimated amount which could be drawn from source in twenty-four hours when the ground is well filled with water, if sufficient pumping capacity was available.
    (*g.*) Where works have been extended the average daily consumption before such extension was made.
    (*h.*) Where the source can be divided into two or more sections the estimated capacity of each.

The correspondents were also requested to furnish any further information upon this subject which might suggest itself to them. Replies to this circular were received from 35 places, and the information thus obtained has been condensed and is given in the table opposite.

The areas of water-sheds in columns 6 and 7 were obtained in most cases by sketching upon the topographical map of the State the outlines of the water-sheds and measuring the included area. In the case of the direct water-sheds (column 6), the results are for the most part only rough approximations, particularly those marked with an asterisk. The estimated capacities of sources as given in columns 13 and 14 were furnished by those connected with the various water works.

Before reviewing the tabulated information, it may be well to call attention to the fact that comparatively few of the ground water supplies have been subjected to a severe test in a dry year like 1880 or 1883, because a large number of them were constructed since that time; and of those constructed at an earlier period the greater number had then been in use so short a time that the draught upon the works was not excessive.

The average yield of the Sudbury River water-shed per square mile during the year 1880 was 580,000 gallons per day and for the four years ending in 1883, 738,000 gallons. In contrast with this we have as the yield in 1887 (the dryest of the four years ending in 1890), 1,154,000 gallons per day per square mile, and as the average yield for the whole four years, 1,381,000 gallons. These figures, showing that the yield of water-sheds during the last four years has been very nearly twice as large as during the dry period of four years ending in 1883, make it evident that records and estimates obtained from sources which are being used nearly up to their full capacity in these comparatively wet seasons will tend to show that the sources will furnish more water than they can be depended upon to furnish during a prolonged drought. In other cases, where only a small part of the capacity of the works is now being used, it is obvious that the pumping records are of value only as showing that the sources will yield at least the amount given; but they do not in any way indicate the maximum capacity of the sources. The table must be used with discretion,

Statistics Regarding the Capacity of Public Water Supplies taken from the Ground.

1	2	3	4	5	6	7	8	INFORMATION REGARDING CAPACITY OF SOURCE.						15
								Pumping Records.				Estimated Capacities.		
								9	10	11	12	13	14	
CITY OR TOWN.	Population in 1890.	Date of Construction.	DESCRIPTION OF WORKS.	Adjacent Stream or Pond.	Approximate Area of Direct Water-shed of Well or Filter-gallery. Square Miles.	Area of Water-shed of Stream or Pond near Ground-Water Source. Square Miles.	Character of the Ground in which Works were Built.	Maximum Year. Gallons per Day.	Maximum Month. Gallons per Day.	Maximum Week. Gallons per Day.	Maximum Day. Gallons per Day.	Dry Season. Gallons per Day.	When Ground is Filled with Water. Galls. per Day.	REMARKS.
Amesbury (original source).	9,798	1885	Well 20 feet in diameter and 30 feet deep, thirty-six 2-inch tubular wells 15 feet deep.	Very small stream,	-		Clay, gravel at bottom,	-			-	100,000	-	No pumping records. Source would not furnish over 80,000 or 100,000 gallons per day and was abandoned.
Amesbury (new source).	-	1886	Two open basins each about 80 x 40 feet. The basin from which most of the water is taken is 14 feet deep, and has fifteen 2-inch tubular wells extending 16 feet below its bottom.	None,	-	-	Gravel and some clay,	-			-	400,000	-	No pumping records. Average consumption about 175,000 gallons per day.
Attleborough,	7,577	1873 1882	Well 13 feet in diameter, bottom 5 or 6 feet below bottom of river; filter-gallery 3 feet wide, 3 feet high and [illegible] feet long, five 2-inch, two 1¼-inch, and one 3-inch tubular wells driven in well and gallery 34 feet below bottom of well.	Ten Mile River,		21.10	Loam, gravel, quicksand, and at bottom gravel,	-	-	-	-	200,000 to 300,000	200,000 to 300,000	No pumping records. An additional supply is contemplated.
Ayer,	2,118	1887	Well 25 feet in diameter at bottom, 25.7 feet deep,	Large Mill Pond,	-	4.74	Gravelly 18.7 feet, then rock,	62,262	85,786	-	-	-	-	Soon after the works were constructed the capacity was estimated at 10,000 gallons per hour, equal to 240,000 gallons per day.
Bradford,	3,720	1890	Eight wells on Porter's Island, in the Merrimack River about 100 feet from the shore; three of them 12 feet square, and two 12 x 24 feet; all 20 feet deep.	Merrimack River,	-	1,819.00	About 16 feet of river silt, then 1 to 4 feet of gravel, then clay.	-	-	-	-	250,000	300,000 to 400,000	No pumping records. About 250,000 gallons per day were pumped in the summer of 1891. Three additional wells are being built.
Braintree,	4,848	1887	Filter-gallery 110 feet long, 15 feet wide and 13.5 feet high, bottom 16.5 feet below high water in Little Pond.	Little Pond,	0.12	0.55	Course, porous gravel,	215,620	361,801	-	557,287	-	-	
Bridgewater, East Bridgewater,	4,249 2,911	1888 1889 1890	Two wells built first, one 60 x 20 and 17 feet deep, the other 20 feet in diameter and 18 feet deep. The third well, built in 1889, is 10 feet in diameter and 33 feet deep. In the bottom of this is a 6-inch tubular well 86.5 feet deep. The fourth well is tubular, 202 feet deep, sunk in 1890. Water is also drawn from a spring near the wells.	Town River,	0.32*	55.82	About 15 feet of clay, then 3 feet of gravel, then ledge.	94,263	131,775	101,643	173,145	--	-	Wells to furnish an additional supply are contemplated.
Brookline (excluding extension)	12,103	1875	Filter gallery in two sections, 191 and 571 feet long, connected by a conduit 380 feet long. From 4 to 6 feet in width and height.	Charles River,		131.20	Gravel and coarse sand,	864,509	1,258,999	-	-	750,000	-	
Brookline (including extension).	-	1875 1890	The extension made in 1890 consists of forty-four 2½-inch tubular wells averaging 35 feet in depth, included in a length of about 2,500 feet.	Charles River,	-	134.20	Tubular wells sunk through about 25 feet of peat, muck and quicksand into porous gravel.	964,873	1,258,999	1,136,137	1,829,650	1,300,000	4,000,000	
Canton,	4,638	1889	Well 40 feet in diameter and 25 feet deep, twelve 2-inch tubular wells in the vicinity are connected by siphon.	Beaver Brook,	0.21*	2.47	Close clayey gravel, very hard at bottom,	79,106	-	143,126	224,136	250,000	600,000	The 224,136 gallons were obtained by pumping out practically all of the water in the well.
Cohasset,	2,448	1886	Sixty-one tubular wells, each 2 inches in diameter and 30 to 40 feet deep, included in an area 725 feet long and 90 feet wide.	Small Brook,	-	0.42	Sixteen to 25 feet of muck, clay, sand, and blue clay, then gravel at bottom.	61,971	114,708	160,507	346,150	-	550,000	
Dedham,	7,123	1881	Well 26 feet in diameter, 18 feet deep, situated 40 feet from the river,	Charles River,	0.15*	194.01	Sand and coarse gravel,	221,814	336,567	400,843	651,240	900,000	1,500,000	
Easton,	4,193	1887	Well 20 feet in diameter at the top and 27 feet at the bottom; 26 feet deep,	Queset River,	0.14*	4.22	Clayey gravel,	101,771	125,367	161,233	248,660	-	-	A small storage reservoir has been constructed in the valley just above the well.
Framingham,	9,239	1885	Filter-gallery at edge of pond 160 feet long, 3½ to 4 feet wide and 4 feet high, bottom of gallery 6 feet below surface of pond.	Farm Pond,	0.10	-	Course and fine sand,	239,248	118,656	496,735	578,397	1,000,000	1,000,000	Supplies only South Framingham and a portion of Framingham Centre.
Franklin,	4,831	1881 1887	Two wells, one 20 feet in diameter and 25 feet deep, the other 33 feet in diameter and 18 feet deep.	Mine Brook,	-	7.68	Gravel for 8 feet, then ledge,	90,675	110,630	-	253,800	300,000	600,000	
Grafton,	5,002	1886	Filter-gallery 95 feet long, 12 feet wide and 17 feet high; bottom is 20 feet below surface of ground.	Quinsigamond River,	-	15.05	Three feet of peat, below that blue gravel to bottom of gallery, then ledge.	-	-	-	138,000	-	1,000,000	An artesian well 6 inches in diameter and 97 feet deep was sunk in 1889, but not connected with the works until July, 1891.
Hopkinton,	4,088	1884	Three tubular wells each 6 inches in diameter, 59, 65 and 75 feet deep, near summit of a large hill. Wells included in a distance of 200 feet.	None,	V'y small,	-	From 3½ to 18 feet of clay and gravel, then rock broken by seams.	Estimated 40,000	-	Estimated 60,000	Estimated 70,000	10,000	125,000	An 8-inch well, 119 feet deep, has been added, but is not included in making these estimates.
Hyde Park, Milton,	10,193 4,278	1885	One hundred and thirty-two 2-inch tubular wells 34 to 38 feet deep included in an area about 1,000 feet long and 150 feet wide.	Neponset River,	0.46*	91.80	Porous gravel,	437,531	610,000	800,000	940,800	-	-	
Kingston,	1,659	1886 1888	Well 20 feet in diameter. Filter-gallery 360 feet long, 20 inches wide and 14 inches high,	Jones River,	-	22.24	-	-	-	-	-	-	170,000	
Lexington,	3,197	1884	Four large wells, also 8-inch tubular well 190 feet deep, all but 14 feet in rock,	Vine Brook,	V'y small,	0.60	Wells sunk through peat and hard pan into rock.	Estimated 90,000	-	-	-	-		In a dry time a part of the supply has to be taken from supplementary sources.
Malden,	23,031	1889	Fifty-one 2-inch tubular wells sunk to an average depth of 65 feet included in an area 100 by 300 feet.	None,	1.61†	-	Wells sunk through peat, clay and compact sand, averaging 55 to 60 feet in depth, into porous gravel.	717,146	940,403	1,041,881	1,172,592	500,000	1,200,000	There is an additional area of watershed of 1.5 square miles, which is possibly tributary to the wells under certain conditions.
Mansfield,	3,432	1888	Well 25 feet in diameter and 20 feet deep, 625 feet from the river,	Canoe River,	-	1.35	Porous gravel,	157,968	179,866	-	395,170	-	-	The maximum day's pumping lowered the water in the well 4.5 feet. The amount pumped during construction in a very wet season was estimated at 3,000,000 gallons.
Middleborough,	6,065	1885	Well 26 feet in diameter and 22 feet deep, 100 feet from the river,	Nemasket River,	-	60.90	Coarse loose gravel,	142,730	205,935	247,428	389,000	1,000,000	2,000,000	In July, 1888, when the stand-pipe was shut off for ten days, and continuous direct pumping was resorted to, about 500,000 gallons were pumped daily and the ground water lowered but little more than a foot.
Newburyport,	13,947	1881	Two wells, one 20 feet diameter and 18 feet deep; the other is smaller. A small storage reservoir fed by springs is near the wells.	Merrimack River,	-	-	Porous gravel,	443,047	503,818	564,490	649,359	-	-	
Newton (excluding extension made in 1890).	24,379	1876 1886	Filter-basin 1,575 feet long, 10 feet wide at bottom, 68 to 75 feet wide at high-water mark; bottom 10 feet below water in river. Eight tubular wells in bottom of basin, 1¼ to 4 inches in diameter, also four 6-inch and four 4-inch tubular wells on opposite side of river.	Charles River,	-	140.50	Filter-basin in fine gravel, sand and quicksand. Tubular wells sunk to coarse sand or gravel.	915,013	1,218,387	-	1,747,000	1,050,000		These works in 1886 furnished 1,050,000 gallons per day after pumping for six weeks in very dry weather.
Newton (including extension made in 1890).		1876 1886 1890	The extension made in 1890 consists of one hundred and seventy-four 2½-inch tubular wells, from 21 to 130 feet deep, connected with a wooden conduit 2,352 feet long and 4 feet square in section, 742 feet of this conduit replace an equal length of filter-basin.	Charles River,	-	140.50	The 174 2½-inch wells are sunk in material varying from porous gravel or coarse sand to quicksand or hard pan.	1,041,616	1,100,419	1,339,285	-	2,000,000	6,000,000 to 8,000,000	
North Attleborough,	6,727	1884	Well 30 feet in diameter and 26 feet deep; 470 feet from Whiting's mill-pond,	Whiting's Mill Pond on Ten Mile River	-	4.30	Through quicksand to gravel,	166,575	-	336,535	435,690	500,000	-	
Revere, Winthrop,	5,668 2,726	1884	One well 30 feet in diameter, 20 feet deep, with three 6-inch and two 2-inch tubular wells in the bottom. Another well 40 feet in diameter and 20 feet deep, with one 8-foot well, 30 feet deep, and eight 2-inch tubular wells in bottom. Also one hundred 2-inch tubular wells in the vicinity, comprised in a triangle whose sides are 1,100, 1,300 and 550 feet in length.	Small stream,	0.78‡	0.67	Through clay to gravel, which is reached at from 60 to 70 feet beneath the surface.	465,491	680,411	726,210	1,066,395	780,000	2,000,000	The estimated yield of this source in a dry season (780,000 gallons) is a little less than the amount actually pumped in August, 1891. So large a draught, however, could not be continued during the whole of an ordinary year without exhausting the supply.
Stoughton,	4,852	1886	Well 25 feet in diameter and 30 feet deep,	None,	0.24*	-	Ledge, except near the surface of the ground,	-	-	-	-	-	-	Average daily consumption, estimated at 50,000 gallons per day, requires about all of the water the well will supply.
Swampscott, Nahant,	3,198 880	1885	Well 22 feet in diameter and 20 feet deep, 35 feet from brook, with six 2-inch tubular wells in bottom, driven 50 to 75 feet. Supplementary supply from seventy-two driven wells about 40 feet deep, near the brook above the large well.	Stacy's Brook,	-	2.62	Loam at surface, then blue clay from 5 to 28 feet, with coarse gravel beneath.	251,653	591,788	618,943	1,015,050	400,000 to 600,000	1,200,000	A large portion of the water of Stacy's Brook is diverted into the Lynn intercepting sewer.
Taunton,	25,448	1876	Filter-basin, 100 feet long, 17 feet wide at bottom, bottom 8 feet below low water in river. Filter gallery 863 feet long, 5 feet 2 inches in height, 4 feet in width; bottom level with filter basin. Two tubular wells sunk in bottom 25 to 37 feet deep. Filter-bank 94.6 feet long, 10 feet wide at bottom, 10 feet high.	Taunton River,	-	312.10	Boring at west end of basin showed 10 feet of sandy gravel, 10 feet of sand mixed with clay, 20 feet of clay, 10 feet of clay mixed with fine gravel, 2 feet of fine gravel, 35 feet very hard blue clay, with granite sandstone beneath.	918,137	1,143,086	1,214,358	1,563,738	1,000,000	3,500,000	There is a direct connection with Taunton River, and this water is used when the supply is insufficient. It is estimated that during the days of maximum consumption from one-third to one-half of the water pumped is drawn from the river.
Tisbury,	1,506	1887	Filter-gallery 38 feet long, 7 feet wide at bottom, 10 feet high,	Lake Tashmoo,		-	Sand,	-	-	-	-	-	-	The gallery can be pumped out in three hours with a pump having a capacity of 1,000,000 gallons in 24 hours, and will fill again in about 45 minutes.
Waltham,	18,707	1873	Filter-basin of irregular shape, having an area of about one-fourth of an acre. Bottom is 8.5 feet below the average level of water in the river.	Charles River,	1.11§	181.00	Porous gravel,	687,749	943,737	1,243,469	1,518,200	1,100,000	-	Works are now being built to increase the supply of water.
Ware,	7,329	1886	Well 26 feet in diameter, and 22 feet deep,	Muddy Brook,	0.37*	10.44	12 feet of clay, then coarse gravel,	179,676	260,040	292,419	462,900	861,000	1,000,000	
Watertown, Belmont	7,073 2,098	1885 1889 1890	Filter-gallery in three sections, 90 feet long, 15 feet wide, 175 feet long, 3 feet wide, and 2 feet high, 102 feet long and 8 feet wide. The last is at right angles to the other two, and all are on a level. In 1889, twenty 2-inch tubular wells were added. In December, 1890, a well 20 feet in diameter and 24 feet deep was completed.	Charles River,	-	197.80	1 to 1.5 feet of loam, 15 feet of coarse gravel, about 15 feet of fine sand with ledge beneath.	361,213	530,600	597,857	1,302,500	1,000,000	5,000,000	
Wellesley,	3,600	1884	Filter gallery 63 feet long, 11 feet wide at bottom, and 17 feet deep. Large well, 22 feet in diameter and 20 feet deep, at Williams' Spring.	Rosemary Brook,	-	4.28	The filter-gallery is built in a compact hard-pan. The well at Williams' Spring is in loose gravel.	257,875	335,051	307,886	463,290	-	-	The amount that could be obtained from this source in a dry year is probably less than is being used at present. Fully three-fourths of the water now comes from the well at Williams' Spring.
Whitman,	4,441	1883	Filter-gallery built in two sections. First section 100 feet long, 15 feet wide, and 14 feet deep; bottom is about 12 feet below high water in the pond. Second section 116 feet long, 18 inches wide, and 20 inches high.	Hobart's Pond,	0.06*	6.40	A hard clay through which water filters very slowly. Ledge is found 20 to 25 feet beneath the surface.	103,276	175,191	266,229	451,635	Without drawing from pond 125,000	175,000	A direct connection with the pond is used in order to obtain a sufficient supply whenever the amount furnished by the well is too small.
Woburn,	13,499	1873	Filter-gallery 82 feet long and 12 feet wide, with side walls 9 feet in height, surmounted by a brick arch. The bottom of the gallery is about 8 feet below high water in the pond.	Horn Pond,	0.21	7.44	Porous gravel,	951,589	1,137,124	1,172,850	1,308,300	1,300,000	4,000,000	

* Very rough approximation.

‡ This area includes the whole water-shed of the brook opposite the wells, and some territory below the wells, which probably contributes water to them.

† The area contributing to this source varies with the amount of water pumped. The figure given is an engineer's estimate of the area tributary to the wells under normal conditions.

§ This area, including territory on both sides of the river, is probably in excess of that which has contributed to the supply in the past.

but it is believed that when so used it will be of considerable value to those selecting sources of ground water supply.

The table represents so much variation in conditions and in value of data that it is hardly feasible to make any summary of it. It may be well, however, to call attention to a few prominent features.

The largest supplies taken wholly from the ground are as follows: —

City or Town.	Average Daily Pumping, Maximum Year.
Newton,	1,041,616 gallons.
Brookline,	964,873 "
Woburn,	951,589 "
Waltham,	687,749 "

It is noticeable that these supplies are all taken from the ground in the vicinity of large bodies or streams of water. Newton and Brookline have recently extended their works, which are now expected to yield, respectively, 2,000,000 and 1,500,000 gallons daily in a dry season. These estimates, made by engineers of long experience, are probably conservative, and may be said to represent the largest supplies of ground water yet obtained in this State. Waltham is now increasing the capacity of its source with a prospect of obtaining as much water as either Newton or Brookline. It is noticeable, however, that the ease with which these large quantities are obtained varies very much. At Waltham, it is expected to obtain the desired supply from a well 40 feet in diameter, while at Newton the works cover a total length along the river of about 4,300 feet. At each of these four places the ground water is kept pumped down below the level of the neighboring body of surface water, and there is reason to think that much of the supply is filtered surface water.

There are several supplies where a large amount of water is obtained from direct water-sheds, without being supplemented by filtration from surface water sources. As instances, the supplies of Malden, Newburyport and Revere may be mentioned.

The maximum amount pumped from these sources has been as follows: —

City or Town.	Average for the Year. — Gallons per Day.	Average for the Month. — Gallons per Day.
Malden,	747,446	940,403
Newburyport,	443,047	503,818
Revere,	465,491	680,411

At Malden, the amount pumped in 1890 represented a collection of 9.7 inches (or 20 per cent. of the total rainfall of 49 inches) upon a direct water-shed estimated at 1.61 square miles. At Revere, the pumping for the year ending June 30, 1891, represented a collection of 12.5 inches (25 per cent. of the total rainfall of 50 inches) upon a water-shed of 0.78 square miles. At all three of these places it is probable that the amount which has been pumped is more than could be pumped after one or two years of low rainfall. At Revere, particularly, experience has shown that the storage capacity of the ground is very large, so that when the water table is reduced to a very low level during the summer, the ground will not fill before the next summer unless the amount of rainfall is above the average.

It has already been mentioned that the amount of chlorine found in the water of the filter-gallery at Woburn shows that a large proportion of the water comes from Horn Pond. A comparison of the amount pumped from the gallery with the precipitation upon the direct water-shed leads to similar conclusions. The amount pumped during the year ending Aug. 31, 1887, was 951,589 gallons per day. The precipitation during the same period equalled 42.3 inches, which upon the direct water-shed of 0.21 square miles was equivalent to 423,000 gallons per day. The amount which can be collected is much less than the total precipitation. If we use the proportion collected at Revere (25 per cent.) as a basis, the yield from the direct water-shed at Woburn during the year mentioned would have been 105,750 gallons per day, or about one-ninth of the amount actually pumped.

As instances of supplies where ground water is obtained only in small quantity, in proportion to the extent of the works, we may mention those at Lexington and Bridgewater.

At Lexington, with four large wells and a deep tubular well, the supply obtained in a dry summer is less than 100,000 gallons daily. This is owing both to the small water-shed tributary to the wells, and to the unfavorable character of the ground for storing water in the wet season of the year where it will maintain the yield of the well in the dry season.

At Bridgewater, two wells, one very large, were completed in 1888, but the next year, when the consumption of water in summer was about 75,000 gallons per day, it was found advisable to add another large well with a deep six-inch tubular well in its bottom, and in 1890 a second tubular well was sunk. The works as they now stand do not furnish any very large excess above the present consumption of about 130,000 gallons per day in summer, so that a further extension of the works is contemplated. These instances are mentioned to show that works of considerable extent do not necessarily furnish much water, unless the ground is porous, and there is either a large direct water-shed, or a neighboring stream or pond to saturate the ground.

The returns show that, in Massachusetts, wells excavated in rock do not furnish large quantities of water; and, as we have already noted, deep wells bored in rock give much less favorable results than are obtained by more shallow wells in gravel or other porous material. As a further indication that these deep wells are unsatisfactory, the following table is reproduced from the report of the Taunton Water Commissioners for 1889.*

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* Fourteenth Annual Report of the Water Commissioners of Taunton, Mass., Nov. 30, 1889, pp. 26, 27.

Table giving Statistics regarding Deep Wells sunk in Rock,

Number.	Location of Wells.	Diameter in Inches.	Depth in Feet.	Gallons in Twenty-four Hours.	Rock Strata.
1	York Beach, Me.,	6	51	120,000	Hard sandstone.*
2	Bennington, Vt.,	–	1,000	–	– –
3	Bennington, Vt.,	–	1,000	–	– –
4	Boston, No. 34 Providence Street,	7⅜	2,503	Inexhaustible,	Granite and slate.
	Boston Gas Light Co.'s wells:				
5	Boston, Commercial Street,	–	1,750	–	Slate.
6	Dorchester, Commercial Point,	–	870	–	Slate and conglomerate.
7	Dorchester, Old Harbor Point,	–	900	–	Slate and conglomerate.
8	Dighton,	6	50	200,000	– –
9	Hopkinton,	6	58	50,000	Broken granite.
10	Hopkinton,	6	65		Broken granite.
11	Hopkinton,	6	75		Broken granite.
12	Hopkinton,	8	119	88,000	Broken granite.
13	New Bedford, Clark's Cove Guano Co.,	6	510	5,000	Granite and limestone.
14	North Adams,	8	500	900,000	Limestone.
15	North Adams,	8	500		Limestone.
16	Northampton, Belden Silk Mill,	8	3,700	7 gallons per minute.	Conglomerate sandstone.
17	Lowell, Hosiery Co.,	6-4	303	24,000	Trap or mortar stone.
18	Malden,	8	650	93,600	– –
19	Stockbridge,	8	300	40,000 to 60,000	Quartz.
20	Stockbridge,	8	650	–	Limestone and mica schist.
21	Fall River,	6	180	43,200	Granite.
22	Taunton, Lunatic Hospital,	6	89	90,000	Blue granite.†
23	Taunton, Morton Laundry,	6	96	20,000	Slate and sandstone.
24	Taunton, Water Works,	8	975	75,000	Slate and sandstone.
25	West Cummington,	8	625	3,600	– –
26	Darien, Conn., Fitch's Soldiers' Home,	6	215	16,800	Granite.
27	Darien, Conn., Fitch's Soldiers' Home,	8	251	8,000 to 12,000	Conglomerate.
28	Darien, Conn., Fitch's Soldiers' Home,	8	80	12,000 to 20,000	Schist.
29	Meriden, Conn.,	8	208	Using 57,600	Red sandstone.
30	Meriden, Conn.,	8	205		Red sandstone.
31	Meriden, Conn.,	8	256		Red sandstone.
32	Meriden, Conn., Brittania Works,	12	530	100,000	Brown sandstone.
33	Stamford, Conn.,	8	450	–	– –
34	Newport, R. I., Electric Light Co.,	8	110	75,000	Dark slate.

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* Sometimes called "blue granite."

† Called by geologists sandstone.

taken from the Report of the Taunton Water Commissioners for 1889.

Number.	Depth at which Rock was First Reached.	Does Well Flow?	Quality of Water.	Result of Exploding.	REMARKS.
1	2	Yes,	Good,	No shot.	
2	100	– –	– –	– –	Failure.
3	20	– –	– –	– –	Failure.
4	159	5 feet of surface,	Too much sulphuretted hydrogen.	No shot,	Good water 459 to 484; well spoiled by going too deep.
5	80	No,	Much mineral and vegetable matter.	– –	
6	–	– –	Salt,	– –	
7	–	– –	Salt,	– –	
8	15	5 feet of top,	– –	No shot,	J. C. Jessup & Co., owners.
9	18	No,	Fine,	No shot.	
10	14	No,	Fine,	No shot.	
11	8	No,	Fine,	No shot.	
12	2½	No,	Fine,	No shot.	
13	12	No,	Too near salt water,	Good results.	
14	80	4 feet of surface,	Good, but very hard.	No shot.	
15	80	4 feet of surface,	Good, but very hard.	No shot.	
16	150	No,	Not good,	700 pounds dynamite; total failure.	
17	15	No,	Poor,	Twice, gained 25 per cent.	
18	70	No,	Fair,	No shot.	
19	50	No,	Fair,	– –	
20	–	No,	– –	– –	This well an utter failure.
21	13	No,	Fair,	No shot.	
22	27	No,	Good,	No shot.	
23	26	1 or 2 gallons per minute.	Good,	No shot.	
24	85	12 feet of surface,	Good,	No shot.	
25	10	No,	Too much iron,	No shot.	
26	42	– –	– –	– –	
27	20	Flows few gallons per hour.	– –	Shooting did no good.	
28	20	– –	– –	– –	
29	15	Yes,	Hard, clear,	Good results.	
30	15	Yes,	Hard, clear,	Good results.	
31	15	Yes,	Hard, clear,	Good results.	
32	90	No,	"Hard as lightning."	No shot.	
33	–	No,	Brackish,	No shot.	
34	11	No,	Very hard,	No shot.	

QUALITY OF SURFACE WATER.

As indicated in the introduction to this paper the quality of water for the supply of a city or town has to be considered from several points of view. First and most important, it must not be injurious to the health of the community. Second, it must not have a disagreeable odor or be unpalatable. Third, it should not be too hard for washing and for use in boilers.

The most important factor in making water dangerous to the health of the community is the discharge of human sewage into it, whereby the germs of specific diseases may be introduced into the water. We may, therefore, say in general terms that a water will be dangerous to health in proportion to the density of population upon the water-shed from which the supply is derived. This statement, however, needs much qualification, because it makes a very great difference whether the sewage of the population enters the water directly or is filtered through the ground from cesspools; and, even in cases where sewage does enter the water more or less directly, the time which elapses between such entrance and the drinking of the water is a very important element. For instance, the discharge of the sewage of the city of Lowell into the Merrimack River, so that within a day it may reach the intake of the Lawrence water works, is a much greater menace to the health of the inhabitants of Lawrence than the discharge of a corresponding amount of sewage from Natick into the southerly division of Lake Cochituate (where the passage to the northerly division, from which water is drawn, requires months of time) is to the health of the city of Boston. On account of this quicker transmission of the infectious matter by streams it seems fair to say that, when polluted, they are more dangerous as sources of water supply than reservoirs and ponds.

Surface water may have a dark color owing to the drainage from swamps; or that flowing in streams may become turbid with suspended mineral matter after rains; or the water of reservoirs and ponds may be somewhat turbid and have a disagreeable taste and odor, owing to the presence of algæ and other minute organisms. It is the presence or absence of these features which can be recognized by the senses that generally determines the quality of a water in the public mind. The organisms which produce the disagreeable tastes and odors are not the so-called disease germs, and the experience of cities and towns using waters which generally contain these organisms does not indicate that they have a noticeable influence upon the health of the community. When present in large numbers, however, they often make the water so disagreeable to the senses that it is unfit for drinking, and in this way are a great evil. They very rarely occur in abundance in the water of streams, but are most frequently abundant in stored waters. All stored waters, however, are not equally affected, the character of the water and the manner in which it is stored having an important influence upon the amount of these growths. This subject was fully discussed in the special report of the Board on Water Supply and Sewerage, Part I., 1890, pp. 740–749.

As a result of this discussion it was found that unpolluted deep ponds generally furnished a water free from bad tastes and odors, and deep storage reservoirs prepared by the removal of all of the soil and vegetable matter from the bottom and sides were equally satisfactory for the storage of water. The effect of density of population upon the water-shed was also found to be one of the most important factors in causing these troublesome growths, which seem to develop in abundance where the water is supplied with nitrogenous matter from sewage and the animal manures produced or used in populous districts. The effect appears to be nearly the same when the sewage is purified by filtration through the ground before entering the water supply, as when it is discharged directly into it.

Experience shows that where the population exceeds 300 per square mile of water-shed, the stored water, whether contained in a natural pond or artificial reservoir, is particularly liable to produce an abnormal growth of organisms, and in consequence give trouble from bad tastes and odors. Shallow storage reservoirs from which the soil and vegetable matter have not been removed generally give trouble, and the large and deep reservoirs of the same character are by no means exempt.

The color of the water which enters the pond or reservoir does not appear to have a marked effect upon the growth of organisms. A water having much color generally has a noticeable taste caused by the vegetable matter in solution which produces the color. This taste, however, is not particularly disagreeable.

Natural waters from regions where limestone abounds are frequently too hard to be satisfactory, either for washing or boiler purposes; but in Massachusetts these conditions exist only in limited portions of the western part of the State. In the eastern portion of the State the natural waters are soft, and it is only through pollution that they become hard. There are, however, very few surface waters, except in the extreme western part of the State, which are not suitable for washing and for use in boilers.

There are several ways in which the purification of surface water of unsatisfactory quality can be effected by artificial methods, — as, for instance, by filtration through sand; but this can only be done with considerable difficulty and expense. It is therefore the best plan, in selecting a surface water, to obtain one which will not require artificial purification. When water is taken from the ground near streams and ponds it is often to a large extent surface water so thoroughly filtered that it cannot be distinguished from the natural ground water. This method of purification by natural filtration is an excellent one to adopt where there is a sufficient area of porous ground adjoining the surface water source.

Quality of Ground Water.

With ground waters as with surface waters, the quality must be considered from several points of view. First, the water must not be dangerous to health; second, it must be free from any bad taste, odor and appearance which will make it disagreeable as a drinking water; and third, it should be suitable for domestic and boiler uses. The danger to health comes, as with surface waters, from sewage pollution; but a ground water is not as liable to such pollution as a surface water, because during the passage of the water to the well both the suspended and soluble organic matters, including the bacteria, are to a very large degree retained by the ground or oxidized into harmless inorganic compounds.

As a result of this purifying action, ground water draining from a territory which has upon it considerable population (provided it is not too near the well) is often less contaminated than surface waters draining a territory much less thickly populated. This statement is not intended to encourage the location of ground water sources where they will obtain their supply from a populated district, because such action is inadvisable where an entirely uncontaminated source can be obtained, even at a large additional expense; and it is only where such a supply cannot be obtained that the relative merits of supplies from even slightly polluted territory should be considered.

It may be well in this place to call attention to the great difference which usually exists in the quality of water from public and private wells. The former are usually located at a considerable distance from any habitation, so that even if they draw polluted water from populous districts it has to pass a long distance through the ground before reaching the well, and is generally diluted by a large amount of water from other directions entirely free from pollution; and these public wells are also, as a rule, thoroughly protected from the entrance of surface washings or the accidental entrance of other foul matters. The typical private well in a village, on the other hand, often receives a considerable portion of its water from cesspools located so near it that the polluted water does not become at all thoroughly purified by its passage to the well, and the direct entrance of surface and other dirty water and foul matters is not wholly prevented.

In the foregoing statements we have had in mind sources which derive their supply from what we have before called the direct water-shed. In the case of sources which obtain their supply by natural filtration from a neighboring stream or pond, the conditions are somewhat different. Even where the color, taste and odor are so completely removed that these filtered waters cannot be distinguished from the true ground waters, the removal of the organic matter (and probably of the bacteria) is not quite as complete as in the case of the slower and to some extent intermittent filtration from the land side. If, however, we refer to the examples furnished in this State, we find in most instances that the surface waters before filtration are contaminated so little, that after being converted into ground waters by filtration they are about as good from a health standpoint as true ground waters which more frequently derive their supply from populous districts.

There is another class of waters obtained by natural filtration from streams and ponds in such a way that the filtration is very imperfect. These imperfectly filtered waters have some of the characteristics of the surface waters from which they are derived, and some of the characteristics of the true ground waters. They also have certain special features of their own in that they contain an unusual amount of free ammonia, a product of decay, and the organism *Crenothrix*, which grows abundantly in such waters. If the surface waters before filtration are objectionable from a health stand-point, owing to the presence of disease germs, the imperfectly filtered waters are subject to the same objections (though possibly to a less degree) ; and the presence of the intermediate products of decomposition must also be regarded as an unfavorable feature. It is not known that the presence of *Crenothrix* affects the healthfulness of the water, but it is very objectionable for other reasons which will be pointed out subsequently.

With regard to the taste, odor and appearance of ground waters, it may be said that at all public supplies where the water is shown by chemical analysis to be completely purified by filtration, the quality of the water as it comes from the ground is satisfactory. The previous pollution of the water does not give it a disagreeable taste or odor, but, on the contrary, by increasing the mineral contents of the water, makes it if anything more palatable. The only trouble experienced from waters of this class occurs after they have been exposed to the light in open basins or reservoirs, when a bad taste and odor are often produced by the algæ and other organisms which find conditions favorable to their rapid growth in such waters.*

The imperfectly filtered waters retain some of the taste and odor of the surface waters from which they are derived and often have a turbid appearance, owing both to the imperfections of the mechanical filtration and to the presence of the *Crenothrix* already mentioned.

For domestic and boiler uses the completely filtered ground waters are satisfactory if not too hard. In the western part of the State, where there is much limestone, the natural ground waters are frequently too hard to be satisfactory for these purposes; but in other portions of the State, except in the immediate vicinity of the sea, the unpolluted ground waters are but little harder than the surface waters, and not hard enough to be objectionable for either of the uses named. The excessive hardness of many of the village wells and of some public water supplies is due to the inorganic or mineral contents of sewage and other waste matters washed into the ground from which the supply is derived. These soluble mineral contents of polluted water cannot be removed by even the most complete filtration. It will therefore be seen that any pollution upon the water-shed of a ground water supply not only affects the quality of the water from a health stand-point, but also makes the water less satisfactory for domestic and boiler uses.

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* The effect of storing ground waters in open reservoirs is fully discussed in Part I. of the special report of the Board upon Water Supply and Sewerage, 1890, pp. 725-734.

Imperfectly filtered waters are not generally objectionable on the score of hardness; but, as the organism *Crenothrix* has the peculiar property of separating the dissolved iron from water and incorporating it in its sheath, where it exists as iron-rust, such waters are unsatisfactory for use in the laundry because white clothes become much discolored by the rust.

The foregoing statements are not wholly applicable to very deep wells, such as are tabulated on pages 362, 363, although, in the few instances in which wells of this character are used for public water supplies in this State, the quality of the water is about the same as that obtained from the more shallow wells. In other instances the quality of the water obtained from very deep wells has been very unsatisfactory.

It may be thought that the quality of a ground water will vary with the method adopted for its collection; as, for instance, that a driven well will furnish better water than an excavated well or filter-gallery. The examinations of the water supplies of the State do not indicate any noticeable difference in the water collected in these different ways, provided the water is not exposed to the light, and the conditions are not such as to produce imperfect filtration.

Crenothrix is the greatest pest in ground water supplies and, as has been stated, is associated with imperfect filtration. The relation of *Crenothrix* to imperfectly filtered waters has been fully discussed in Part I. of the special report of the Board, 1890, pp. 777–782; but the subject is of so much importance when selecting a ground water supply, that the conditions under which *Crenothrix* has been found in abundance will be referred to here. The principal instances are furnished by the water works at Wayland, Arlington and Whitman. At each of these places the filter-gallery is built near the shore of a reservoir, in material which is not very porous; and at both Wayland and Arlington small branch galleries extend out under the reservoir only a few feet below its bed. In each case the chemical analyses show that the water is imperfectly filtered and contains the products of decay. It may also be mentioned that in each case the unfiltered reservoir water contains a large amount of organic matter.

There are other instances in the State where attempts have been made to obtain filtered water by means of systems of open-jointed pipes laid beneath the bottoms of reservoirs; but the quality of the water obtained has not been good, owing probably to imperfect filtration and *Crenothrix*. Still other instances in which a growth of *Crenothrix* has caused trouble are given on the following page.

Crenothrix has appeared in some of the ground water supplies in the State where the filtration is nearly complete, but has not multiplied to such an extent as to cause any serious trouble.

It may be asked how far it is necessary to place a well or filter-gallery from a stream to insure a practically complete filtration of the water. There are several instances in the State where the bank intervening between the stream and the well or filter-gallery is not more than twenty or thirty feet in thickness, and yet the water obtained is very completely filtered. These sources, however, are located in very porous ground; and it is probable that, owing to the silting up of the bed of the stream opposite the well or filter-gallery, by far the greater part of the water has to filter by a very circuitous course. It is best, however, where practicable, to place the well or filter-gallery as much as one hundred feet from the stream, and if the material is so impervious that a sufficient quantity cannot be obtained at this distance, it may be said that the conditions are not favorable for obtaining a supply of ground water.

In addition to the ground waters, already discussed, which it has been practicable to group with reference to certain special characteristics, there are others met with under special conditions which present some peculiar features.

Wells driven in the sand in some parts of Provincetown, at the end of Cape Cod, furnish water having a very high color and a strong odor. This may be accounted for by the existence of deposits of organic matter, largely of marine origin, beneath the sand drifts of this region.

In the water supply of the Westborough Insane Hospital, taken from driven wells near Chauncy Pond, the amount of free ammonia in the water has always been extremely high, and after several years' use of the wells has increased about a half. The organic nitrogen has also increased to more than twice the original amount, and *Crenothrix* and other organic growths are now found in the pipes, making the water unsatisfactory for use in the laundry on account of the rusty stain left upon the clothes.

Wells sunk at Lexington in peat, hard pan and rock furnish water having considerable color, and some other characteristics of surface water.

There is an instance where water taken from a filter-gallery beneath the bed of an old mill-pond has color and turbidity, owing to the presence of *Crenothrix* and *Zoöglœa*, is hard, and has an offensive odor. In another instance, wells driven in a salt marsh have furnished very hard water. Still another instance may be mentioned in which a driven well near a large swamp has furnished a water which was colorless when drawn, but acquired considerable color on standing for a day, and also had the odor of sulphuretted hydrogen.

These special cases have not been sufficiently investigated to warrant an extended discussion at the present time, but they are mentioned to indicate the necessity, notwithstanding the general good character of ground waters, of having analyses made of water from test wells, and of considering carefully what changes in the character of the water may occur when the currents of water in the ground are changed by continuous pumping.

FOOD AND DRUG INSPECTION.

REPORT UPON FOOD AND DRUG INSPECTION.

The following report embraces the work of the Board, which has been conducted during the year ending Sept. 30, 1890, under the provisions of chapter 263 of the Acts of 1882 and chapter 289 of the Acts of 1884.

The following analysts and inspectors have constituted the working force of the Board, and have performed the duties required by the statutes and the regulations of the Board relative to food and drug inspection : —

Dr. Bennett F. Davenport,	*Analyst.*
Dr. Charles Harrington,	*Analyst.*
Prof. Charles A. Goessmann,	*Analyst.*
Dr. Charles P. Worcester,	*Analyst.*
John H. Terry,	*Inspector.*
John F. McCaffrey,	*Inspector.*
Horace F. Davis,	*Inspector.*

The number of samples of food and drugs examined during the year was 5,985, which was larger than that of any previous year, making the total number of samples examined under the provisions of the acts relating to food and drug inspection 35,671.

The following summary presents the classified statement in brief of the work done during the year : —

Number of samples of food examined,	5,585
" " " found to be pure,	3,771
" " " adulterated, or not conforming to the statutes,	1,814
Percentage of adulteration,	32.5
Number of samples of milk (included above),	3,236
" " " above standard,	1,858
" " " below standard, or otherwise adulterated,	1,378
Percentage of adulteration,	42.6

Number of samples of drugs,	400
" " " of good quality,	325
" " " not conforming to the statutes,	75
Percentage of adulteration,	1.87

Total examinations of food and drugs,	5,985
" " of good quality,	4,096
" " not conforming to the statutes,	1,889
Percentage of adulteration,	31.5

A further summary is also presented, for the purpose of comparison with the work of previous years: —

SUMMARY.	YEARS.								TOTAL.
	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	
Number of samples of food examined,	695	1,962	3,771	3,438	4,870	4,904	4,854	5,585	30,079
" " found to be pure,	363	779	2,180	2,186	3,163	3,385	3,213	3,771	19,040
" " found to be adulterated, or not conforming to the statutes,	332	1,183	1,591	1,252	1,707	1,519	1,641	1,814	11,039
Percentage of adulteration,	47.8	60.3	40.3	36.4	35.1	30.9	33.8	32.5	36.7
Number of samples of milk examined (included above),	218	1,123	2,219	2,085	3,081	2,825	3,219	3,236	18,006
" " above standard,	35	347	1,297	1,323	1,900	1,705	1,971	1,858	10,436
" " below standard,	183	776	922	762	1,181	1,120	1,248	1,378	7,570
Percentage of adulteration,	83.9	69.1	41.7	36.5	38.3	39.6	38.7	42.6	42.0
Number of samples of drugs examined,	603	682	1,007	888	550	862	600	400	5,592
" " of good quality,	357	431	571	463	400	634	503	325	3,684
" " adulterated, as defined by the statutes,	246	251	436	425	150	228	97	75	1,908
Percentage of adulteration,	40.8	36.8	43.3	47.8	27.3	26.4	16.2	18.7	34.1
Total examinations of food and drugs,	1,298	2,644	4,778	4,326	5,420	5,766	5,454	5,985	35,671
" " of good quality,	720	1,210	2,751	2,649	3,563	4,019	3,716	4,096	22,724
" " not conforming to the statutes,	578	1,434	2,027	1,677	1,857	1,747	1,738	1,889	12,947
Percentage of adulteration,	44.5	54.2	42.4	38.7	34.3	30.3	31.9	31.5	36.3
Expense of collection, examination and prosecution,	$2,931 56	$5,529 60	$8,557 43	$8,025 34	$8,803 62	$8,915 41	$10,356 28	$10,013 04	$63,132 28
" " " per sample,	2 26	2 09	1 79	1 85	1 62	1 54	1 89	1 67	1 77

FOOD.

With reference to the comparative freedom from adulteration which prevails among certain articles of food, the Board has been accustomed to publish a statement in its monthly bulletin upon food and drug inspection, to the effect that "certain staple products, such as sugar, flour and the various other cereal products, are very rarely adulterated, and require but little inspection. The work of the Board is therefore mainly devoted to the inspection of such articles as it has found, by several years of experience, to be especially liable to adulteration."

The foregoing statement applies, without limitation, to the investigations of the Board during the past year. Fortunately, harmful adulterations are of rare occurrence, with the single exception of the fraudulent introduction of water into milk, a method of adulteration which is not only productive of harm in a negative way, by the impoverishment of this valuable food, but also frequently by the introduction of water from polluted sources.

The principal articles which are found to be adulterated are milk, butter, lard, olive oil, vinegar, cream of tartar, spices of various kinds, especially pepper, molasses, syrups, honey and other articles into which glucose enters as an ingredient, and coffee.

With few exceptions, but little trouble has been experienced during the past year from manufacturers and wholesale dealers doing business in Massachusetts. On the other hand, more or less annoyance is constantly occasioned by the introduction of adulterated articles coming from manufacturers and wholesale dealers in neighboring States. Many of the complaints which have been entered in the courts in the four western counties of the State during the past year have been of this character.

The following list comprises the articles of food, exclusive of milk, which were obtained by the inspectors during the year and were submitted to the analysts of the Board for examination: —

	Total.	Genuine.	Adulterated.
Allspice,	70	67	3
Baking powders,	8	1	7
Butter and oleomargarine,	164	110	54
Candy,	14	14	–
Canned vegetables,	2	2	–
Cassia,	159	150	9
Cayenne,	20	17	3
Cheese,	22	22	–
Chicory,	1	1	–
Cloves,	143	124	19
Cocoa,	7	4	3
Coffee,	21	18	3
Cream of tartar,	254	224	30
Curry,	1	1	–
Egg custard,	1	1	–
Crystallized figs,	1	1	–
Gelatine,	2	2	–
Ginger,	72	66	6
Honey,	29	23	6
Lard,	22	15	7
Lemon juice,	4	1	3
Mace,	15	13	2
Maple sugar,	24	19	5
Maple syrup,	33	20	13
Molasses,	507	439	68
Mustard,	66	45	21
Nutmeg,	2	2	–
Olive oil,	16	4	12
Pepper, black,	185	152	33
Pepper, white,	25	20	5
Pimento,	3	3	–
Sage,	1	1	–
Salad oil,	1	1	–
Savory,	1	1	–
Soda,	12	12	–
Sugar,	25	23	2
Syrup,	3	–	3
Tea,	66	66	–
Extract of vanilla,	2	1	1
Vermicelli,	1	1	–
Vinegar,	105	65	40
TOTAL,	2,110	1,752	358

The articles which appear prominently in this list are butter, cream of tartar, the different spices, honey, maple syrup, molasses and vinegar. More definite information as to the character of the adulteration in these articles will be found in the reports of the analysts of food.

It is worthy of notice that all of the samples of molasses found to be adulterated contained glucose only as a substitution.

The Artificial Coloring of Vegetables with Sulphate of Copper.

In the nineteenth report of the Board (1887) it was stated that the sale of canned vegetables which were found to be colored with sulphate of copper was deemed to be contrary to the provisions of the Act of 1882 relative to food and drug inspection. The reasons for this opinion were concisely stated in that report, and parties selling such preparations were notified that their sale was in violation of the statutes.

In support of this opinion, as well as of the impropriety of sanctioning in general the sale of food preparations containing poisonous substances, the action of the sanitary authorities of Glasgow is worthy of notice as bearing upon this special question. In their report, dated Nov. 24, 1890, entitled "A Report on the Greening of French Vegetables with Sulphate of Copper," the question is very clearly stated as follows: —

> It appears that a commission was appointed by the Comité Consultatif d'Hygiene of France to report upon the question in 1877. This committee denounced the practice of coloring food with sulphate of copper in the strongest terms. M. Pasteur added his condemnation of the practice in the following terms: "The administration ought not the less to forbid the treatment of preserved food stuffs with salts of copper. The person who asks for pease, asks for a natural product of vegetation which contains no copper. There can be no tolerance except on one condition, that the maker and the seller shall mark their boxes 'Preserved pease greened with sulphate of copper.' In that case tolerance would amount to absolute prohibition, for it is improbable that any consumer would put up with a food so marked." (Annales d'Hygiene, 1880.)
>
> Other commissioners reported in the same manner, and the French government reaffirmed the prohibition until April, 1889, when the manufacturers so persistently renewed their demands that the prohibition was withdrawn. Toleration had been proposed on the following conditions: —
>
> 1. A maximum limit of copper to be prescribed.
> 2. The nature of the coloring matter to be stated in each can of vegetables.
> 3. Coloring with copper for export to be sanctioned, but *not for home use.*
>
> The reasons for this withdrawal are sufficiently plain and are honestly confessed in the report of M. Grimaux, upon which the withdrawal was based, namely, interference with a national industry. He says: "Our duty as hygieists is difficult. On the one hand, in fact, our proper inclination is to prohibit the introduction into food stuffs of any substance which cannot be held to be a food, and which consequently may be more or less injurious, *but if we adopted this consideration as an absolute rule we should place our industry under troublesome conditions, and that is a consideration which the interests of our country must not permit us to forget.*"

The Scottish authorities, in reviewing this action of the French government, summed up the matter very clearly as follows: —

"After careful consideration of the report by which the withdrawal of the prohibition of the use of copper salts in *reverdissage* in France is supported, we can see nothing in it but a feeble apology for yielding at last to a clamorous and persistent national interest. As representing the consumer, we may ask why all these commissions, reports and experiments to induce us to eat vegetables stained with sulphate of copper? The process is not necessary to preserve them, and thus enable us to have the advantage of cheap vegetable diet at periods of the year when fresh vegetables are not to be had. It is not a case of submitting to a little risk in order that an otherwise inaccessible source of food supply may be thrown open to the people. A French minister of agriculture and commerce tells us that the question involved is one 'simply of coloring, with no other object but to please the eye.' The foolish public expects to get green pease at Christmas such as it gets from the market gardens in summer. The French manufacturer makes them to suit its whim. The consequence is that it eats stale pease greened with sulphate of copper *all the year round*. . . . Internal economic and political considerations form so large an element in this question, from a French point of view, that a single remark may be permitted on their British aspect, and it is this: The cultivator of the genuine fresh green vegetable is grossly prejudiced by the substitution for the produce of our market-gardens of last season's growth of foreign market-gardens, colored so as to mislead the eye."

So far as our own population is concerned this question is not merely one which appeals to the agricultural interests of the community; it is a question which has a direct sanitary bearing, since the actual use of coloring matters in food is almost invariably to give to inferior articles a fictitious value, and to cause old and stale products to imitate those which are new and fresh. The introduction of metallic poisons in any amount whatever should have no legitimate place in the food supply of the people.

The following are the cities and towns to which such notices were sent during the year on account of adulterated articles of food: —

Cities and Towns to which Notices were sent on account of Adulterated Articles of Food.

Amherst,	2	Northampton,	4
Boston,	25	North Andover,	1
Brockton,	1	Norwood,	1
Brookline,	1	Orange,	1
Cambridge,	12	Palmer,	2
Chelsea,	1	Pittsfield,	6
Chicopee,	4	Provincetown,	3
Clinton,	8	Quincy,	5
Fall River,	4	Salem,	2
Fitchburg,	1	Shelburne Falls,	2
Gloucester,	9	Southborough,	1
Greenfield,	3	Springfield,	14
Haverhill,	6	Taunton,	4
Holyoke,	14	Turner's Falls,	4
Hyde Park,	2	Wakefield,	1
Lexington,	1	Ware,	1
Lawrence,	6	Wayland,	4
Lowell,	7	Westfield,	1
Marlborough,	1	Weymouth,	1
Milford,	4	Woburn,	2
Nantucket,	2	Wood's Holl,	3
Natick,	1	Worcester,	7
New Bedford,	1		
Newton,	1	Total,	193
North Adams,	6		

Inspection of Pork.

In the general report of the Board, page xxxix, certain cases of trichinosis are detailed which came to the notice of the Board during the past year.

These cases are of rare occurrence when compared with the frequency of other diseases, although as was shown in the report of Professor Mark in the twentieth annual report of the Board trichinosis was shown to be a disease of quite common occurrence in the hog in Massachusetts, especially in animals fed upon the garbage of the large cities and public institutions. Should the recent national laws relating to the inspection of pork intended for exportation be rigidly enforced it may become a vital question whether such enforcement will not have a tendency to increase the amount of trichinous pork which may be offered for sale in our own markets.

The laws of Massachusetts relative to the inspection of meats and provisions in the towns and cities are permissive only, and allow the appointment of inspectors but do not require such appointment. The regulations of the Secretary of Agriculture suggest the propriety of more definite legislation than exists at present in this State, where large numbers of hogs are annually slaughtered and packed for export.

The following regulation of the Department of Agriculture has special reference to this subject: —

> 15. All hogs reported by the microscopist to the inspector in charge of the cooling-room to be affected with trichina will at once be removed from said cooling-room of said establishment under the supervision of said inspector, or one of his deputies, *and be disposed of by the owner in such manner as may be required by the laws of the State where said factory is situated.*

As these laws and regulations are matters of public sanitary importance they are herewith published in full.

REGULATIONS FOR THE INSPECTION OF SALTED PORK AND BACON FOR EXPORT.

United States Department of Agriculture,
Office of the Secretary,
Washington, D. C., Sept. 12, 1890.

By virtue of the authority conferred upon the Department of Agriculture by section 1 of an act entitled "An Act providing for the inspection of meats for exportation, prohibiting the importation of adulterated articles of food or drink, and authorizing the President to make proclamation in certain cases, and for other purposes," approved Aug. 30, 1890, the following regulations for the inspection of salted pork or bacon for export, and the marks, stamps or other devices for the identification of the same, are hereby prescribed: —

1. Whenever any foreign country, by its laws, regulations or orders, requires the inspection of salted pork or bacon imported into such country from the United States, all packers or exporters desiring to export to said country shall make application to the Secretary of Agriculture for such inspection; also, whenever any buyer, seller or exporter of such meats intended for exportation shall desire inspection thereof, he shall likewise make application to the Secretary of Agriculture for such inspection.

2. The application must be in writing, and shall give the name of the packer of such meats and, if the packer be the exporter, the probable amount of such meats to be exported per week or month for which inspection is requested; the name of the country, or countries, to which such meats are to be exported; the place at which inspection is desired and the date for such inspection. The applicant shall likewise agree to abide by these regulations, and to mark his packages as hereinafter provided.

3. Every package containing salted pork or bacon which has been inspected must be branded or stencilled, both on the side and on the top, by the packer or exporter, as follows: —

For Export.

a. Here give the name of the packer.
b. Here the location and State of the factory where packed.
c. Here give the net weight of the salted pork or bacon contained in the package.
d. If exported by other than packer, the name of the exporter.
e. Name of consignee and point of destination.

The letters and figures in the above brand shall be of the following dimensions: The letters in the words "For Export" shall not be less than three-fourths of an inch in length, and all the other letters and figures not less than one-half inch in length. All letters and figures affixed to the top and side shall be legible and shall be in such proportion and of such color as the meat inspector of the Department of Agriculture may designate.

4. The meat inspector of the Department of Agriculture, having, after inspection, satisfied himself that the articles inspected are wholesome, sound and fit for human food, shall affix to the top of said package a meat inspection stamp, to be furnished by the Department of Agriculture, said stamps bearing serial numbers, and the inspector will write on said stamp the date of inspection. The stamp must be securely affixed by paste and tacks, in such a way as to be easily read when the package is standing on its bottom. No less than five tacks shall be driven through each stamp, one at each corner and one in the middle of the stamp.

The stamp having been affixed it must be immediately cancelled. For this purpose the inspector will use a stencil plate of brass or copper, in which will be cut five parallel waved lines long enough to extend beyond each side of the stamp on the wood of the package. At the top of said stencil will be cut the name of the inspector and at the bottom of said stencil will be cut the district in which inspection is made. The imprinting from this plate must be with blacking or other durable material, over and across the stamp, and in such manner as not to deface the reading matter on the stamp, that is, so as not to daub and make it illegible. The stamp having been affixed and cancelled it must immediately be covered with a coating of transparent varnish or other substance. Orders for stamps must be made by the inspector on the chief of the Bureau of Animal Industry. The inspector, having inspected and found wholesome the contents of said package and affixed the stamp thereon, will issue to the packer or exporter a certificate of inspection, reciting the time and place of inspection, the name of the packer, the name of the exporter and the name of the consignee and country to which exported. He will also place on said certificate the number of the package. One certificate only will be issued for each consignment, and must designate the stamp numbers of all the packages contained in said consignment.

5. The inspector will enter in the stub of his stamp book the information given by the packer's brand on the package inspected, and will report daily on blank form (*m. i. 1*), the number of stamps issued on each date, and all the information required by said blank.

6. The certificates of inspection will be furnished by the Department of Agriculture and be issued in serial numbers and in triplicate form. The inspector will deliver one copy of said certificate to the consignor or shipper of such meat inspected; one copy he will attach to the invoice or shipping bill of such meat, and the third copy he will forward to the chief of the Bureau of Animal Industry of the Department of Agriculture for filing therein. He will likewise make a daily report on blank form (*m. i. 2*) of all certificates issued on that date, and fill out said blank with all the information required thereon.

7. Whenever the inspection of any salted pork or bacon is requested by an exporter or shipper at any other place than where packed, the packages containing such meats are to be opened and closed at the expense of the exporter, and said packages must be branded or stencilled in the same manner and contain the same information as prescribed in the case of inspection for a packer.

J. M. RUSK, *Secretary.*

[PUBLIC — No. 247.]

AN ACT PROVIDING FOR AN INSPECTION OF MEATS FOR EXPORTATION, PROHIBITING THE IMPORTATION OF ADULTERATED ARTICLES OF FOOD OR DRINK, AND AUTHORIZING THE PRESIDENT TO MAKE PROCLAMATION IN CERTAIN CASES, AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture may cause to be made a careful inspection of salted pork and bacon intended for exportation, with a view to determining whether the same is wholesome, sound and fit for human food, whenever the laws, regulations, or orders of the government of any foreign country to which such pork or bacon is to be exported shall require inspection thereof relating to the importation thereof into such country, and also whenever any buyer, seller, or exporter of such meats intended for exportation shall request the inspection thereof.

Such inspection shall be made at the place where such meats are packed or boxed, and each package of such meats so inspected shall bear the marks, stamps, or other device for identification provided for in the last clause of this section: *provided*, that an inspection of such meats may also be made at the place of exportation if an inspection has not been made at the place of packing, or if, in the opinion of the Secretary of Agriculture, a reinspection becomes necessary. One copy of any certificate issued by any such inspector shall be filed in the Department of Agriculture; another copy shall be attached to the invoice of each separate shipment of such meat, and a third copy shall be delivered to the consignor or shipper of meat as evidence that packages of salted pork and bacon have been inspected in accordance with the provisions of this act and found to be wholesome, sound and fit for human food; and for the identification of the same such marks, stamps, or other devices as the Secretary of Agriculture may by regulation prescribe shall be affixed to each of such packages.

Any person who shall forge, counterfeit, or knowingly and wrongfully alter, deface, or destroy any of the marks, stamps, or other devices provided for in this section on any package of any such meats, or who shall forge, counterfeit, or knowingly and wrongfully alter, deface, or destroy any certificate in reference to meats provided for in this section, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding one thousand dollars or imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

Sect. 2. That it shall be unlawful to import into the United States any adulterated or unwholesome food or drug, or any vinous, spirituous or malt liquors, adulterated or mixed with any poisonous or noxious chemical, drug or other ingredient injurious to health. Any person who shall knowingly import into the United States any such adulterated food or drug, or drink, knowing or having reasons to believe the same to be adulterated, being the owner or the agent of the owner, or the consignor or consignee of the owner, or in privity with them, assisting in such unlawful act, shall be deemed guilty of a misdemeanor, and liable to prosecution therefor in the district court of the United States for the district into which such property is imported; and, on conviction, such person shall be fined in a sum not exceeding one thousand dollars for each separate shipment, and may be imprisoned by the court for a term not exceeding one year, or both, at the discretion of the court.

SECT. 3. That any article designed for consumption as human food or drink, and any other article of the classes or description mentioned in this act, which shall be imported into the United States contrary to its provisions, shall be forfeited to the United States, and shall be proceeded against under the provisions of chapter eighteen of title thirteen of the Revised Statutes of the United States; and such imported property so declared forfeited may be destroyed or returned to the importer for exportation from the United States after the payment of all costs and expenses, under such regulations as the Secretary of the Treasury may prescribe; and the Secretary of the Treasury may cause such imported articles to be inspected or examined in order to ascertain whether the same have been so unlawfully imported.

SECT. 4. That whenever the President is satisfied that there is good reason to believe that any importation is being made, or is about to be made, into the United States, from any foreign country, of any article used for human food or drink that is adulterated to an extent dangerous to the health or welfare of the people of the United States, or any of them, he may issue his proclamation suspending the importation of such articles from such country for such period of time as he may think necessary to prevent such importation; and during such period it shall be unlawful to import into the United States from the countries designated in the proclamation of the President any of the articles importation of which is so suspended.

SECT. 5. That whenever the President shall be satisfied that unjust discriminations are made by or under the authority of any foreign state against the importation to or sale in such foreign state of any product of the United States, he may direct that such products of such foreign state so discriminating against any product of the United States as he may deem proper shall be excluded from importation to the United States; and in such case he shall make proclamation of his direction in the premises, and therein name the time when such direction against importation shall take effect, and after such date the importation of the articles named in such proclamation shall be unlawful. The President may at any time revoke, modify, terminate, or renew any such direction as, in his opinion, the public interest may require.

Sect. 6. That the importation of neat cattle, sheep, and other ruminants, and swine, which are diseased or infected with any disease, or which shall have been exposed to such infection within sixty days next before their exportation, is hereby prohibited; and any person who shall knowingly violate the foregoing provision shall be deemed guilty of a misdemeanor, and shall, on conviction, be punished by a fine not exceeding five thousand dollars, or by imprisonment not exceeding three years, and any vessel or vehicle used in such unlawful importation with the knowledge of the master or owner of said vessel or vehicle that such importation is diseased or has been exposed to infection as herein described, shall be forfeited to the United States.

Sect. 7. That the Secretary of Agriculture be, and is hereby, authorized, at the expense of the owner, to place and retain in quarantine all neat cattle, sheep and other ruminants, and all swine, imported into the United States, at such ports as he may designate for such purposes, and under such conditions as he may by regulation prescribe, respectively, for the several classes of animals above described; and for this purpose he may have and maintain possession of all lands, buildings, tools, fixtures and appurtenances now in use for the quarantine of neat cattle, and hereafter purchase, construct or rent as may be necessary, and he may appoint veterinary surgeons, inspectors, officers and employees by him deemed necessary to maintain such quarantine, and provide for the execution of the other provisions of this act.

Sect. 8. That the importation of all animals described in this act into any port in the United States, except such as may be designated by the Secretary of Agriculture, with the approval of the Secretary of the Treasury, as quarantine stations, is hereby prohibited; and the Secretary of Agriculture may cause to be slaughtered such of the animals named in this act as may be, under regulations prescribed by him, adjudged to be infected with any contagious disease, or to have been exposed to infection so as to be dangerous to other animals; and that the value of animals so slaughtered as being so exposed to infection but not infected may be ascertained by the agreement of the Secretary of Agriculture and owners thereof, if practicable; otherwise, by the appraisal by two persons familiar with the character and value of such property, to be appointed by the Secretary of Agriculture, whose decision, if they agree, shall be final; otherwise, the Secretary of Agriculture shall decide between them, and his decision shall be final; and the amount of the value thus ascertained shall be paid to the owner thereof out of money in the Treasury appropriated for the use of the Bureau of Animal Industry; but no payment shall be made for any animal imported in violation of the provisions of this act. If any animals subject to quarantine according to the provisions of this act are brought into any port of the United States where no quarantine station is established the collector of such port shall require the same to be conveyed by the vessel on which they are imported or are found to the nearest quarantine station, at the expense of the owner.

Sect. 9. That whenever, in the opinion of the President, it shall be necessary for the protection of animals in the United States against infectious or contagious diseases, he may, by proclamation, suspend the importation of all or any class of animals for a limited time, and may change, modify, revoke or renew such proclamation, as the public good may require; and during the time of such suspension the importation of any such animals shall be unlawful.

Sect. 10. That the Secretary of Agriculture shall cause careful inspection to be made by a suitable officer of all imported animals described in this act, to ascertain whether such animals are infected with contagious diseases or have been exposed to infection so as to be dangerous to other animals, which shall then either be placed in quarantine or dealt with according to the regulations of the Secretary of Agriculture; and all food, litter, manure, clothing, utensils, and other appliances that have been so related to such animals on board ship as to be judged liable to convey infection shall be dealt with according to the regulations of the Secretary of Agriculture; and the Secretary of Agriculture may cause inspection to be made of all animals described in this act intended for exportation, and provide for the disinfection of all vessels engaged in the transportation thereof, and of all barges or other vessels used in the conveyance of such animals intended for export to the ocean steamer or other vessels, and of all headropes and other appliances used in such exportation, by such orders and regulations as he may prescribe; and if, upon such inspection, any such animals shall be adjudged, under the regulations of the Secretary of Agriculture, to be infected or to have been exposed to infection so as to be dangerous to other animals, they shall not be allowed to be placed upon any vessel for exportation; the expense of all the inspection and disinfection provided for in the section to be borne by the owner of the vessels on which such animals are exported. [*Approved August 30, 1890.*

REGULATIONS FOR THE INSPECTION OF LIVE STOCK AND THEIR PRODUCTS.

United States Department of Agriculture,
Office of the Secretary,
Washington, D. C., March 25, 1891.

The following rules and regulations, being additional to the rules and regulations heretofore made under the act of Congress approved Aug. 30, 1890, are hereby prescribed for the inspection of live cattle, hogs, and their carcasses, by virtue of the authority conferred upon the Secretary of Agriculture under the provisions of the act of Congress approved March 3, 1891, entitled "An Act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, and for other purposes."

Export Cattle Inspection.

1. The order and regulations providing for the inspection of export cattle and sheep, made Oct. 20, 1890, under the provisions of section 10 of the act of Congress approved Aug. 30, 1890, are hereby continued in full force and effect, the same as if made under the provisions of the act of March 3, 1891, and all exporters, to secure clearance for their shipments of cattle, must comply strictly with the said regulations.

Meat Inspection.

2. The proprietors of slaughter-houses, canning, salting, packing or rendering establishments, engaged in the slaughter of cattle, sheep or swine, the carcasses or products of which are to become subjects of interstate or foreign commerce, will make application to the Secretary of Agriculture for inspection of said animals and their products.

3. The said application must be in writing, addressed to the Secretary of Agriculture, Washington, D. C., and shall state the location and address of the slaughter-house or other establishment, the kind of animals slaughtered, the estimated number of animals slaughtered per week, and the character and quantity of the products to go into interstate or foreign commerce from said establishment; and the said applicant in his application shall agree to conform strictly with all regulations or orders that may be made by the Secretary of Agriculture for carrying on the work of inspection at such establishment.

4. The Secretary of Agriculture, upon receipt of said application and after consideration thereof, will give said establishment

an official number, by which all its inspected products will thereafter be known, and this number will be used both by the inspectors of the Department of Agriculture and by the owners of said establishment, to mark the products of the establishment as hereinafter prescribed.

5. The Secretary of Agriculture will appoint and designate a veterinary inspector to take charge of the examination and inspection of animals and their products for each establishment which has been officially numbered, as prescribed by rule 3, and will detail to such inspector such assistants or other employees as may be necessary to properly carry on the work of inspection at said establishment. The inspector appointed, and all employees under his direction, shall have full and free access at all times to all parts of the building or buildings used in the slaughter of live animals and the conversion of their carcasses into food products.

6. The veterinary inspector in charge of said establishment will carefully inspect all animals in the pens of said establishment about to be slaughtered, and no animal shall be allowed to pass to the slaughtering-room until it has been so inspected. Whenever any animal is found on said inspection to be diseased, said animal shall thereupon be condemned by the inspector, and the owner of the same shall at once remove it from the premises and dispose of it in such manner as may be provided by the laws of the State in which said animal is located.

7. The veterinary inspector or his assistant shall carefully inspect at time of slaughter all animals slaughtered at said establishment and make a post-mortem report of the same to the Department. Should the carcass of any animal, on said postmortem examination, be found to be diseased and unfit for human food, the said carcass shall at once be removed from said establishment under the supervision of the inspector and be disposed of in the manner provided by the laws of the State where slaughtered. Any owner of any establishment in which inspections are being made under the provisions of the act of March 3, 1891, who shall wilfully cause or permit any animal which, upon inspection, has been found to be diseased to remain on said premises beyond the time allowed by the inspector in charge for its removal, shall forfeit his right to inspection, and said establishment will, for such time as the Secretary may direct, be refused certificates of inspection upon its products.

8. The carcasses of cattle which leave said establishment as dressed beef will be stamped by said inspector with a numbered stamp issued by the Department of Agriculture, and a record of the same will be sent to the Department at Washington.

9. Each and every article of food products made from the carcasses of animals inspected will be labelled or marked in such manner as the owner of said establishment may direct; said label, however, must bear the official number of the establishment from which said product came and also contain a statement that the same has been inspected under the provisions of the act of March 3, 1891.

A copy of said label must be filed at the Department of Agriculture, Washington, D. C., and, after filing, said label will become the mark of identification, showing that the products to which it has been attached have been inspected, as provided by these rules and regulations, and any person who shall forge, counterfeit, alter or deface said label will be prosecuted under the penalty clause of section 4 of the act of March 3, 1891.

Each and every package to be shipped from said establishment to any foreign country must have printed or stencilled, both on the side and on the top, by the packer or exporter, the following: —

For Export.

a. Official number of establishment.
b. Name of packer.
c. Location and State of factory.
d. Net weight of contents.
e Name of consignee and point of destination.

In case said package is for transportation to some other State or Territory or to the District of Columbia, in place of the words "For Export" the words "Interstate Trade" shall be substituted.

The letters and figures in the above print shall be of the following dimensions: The letters in the words "For Export" or the words "Interstate Trade" shall not be less than three-fourths of an inch in length, and the other letters and figures not less than one-half inch in length. The letters and figures affixed to said package shall be legible and shall be in such proportion and of such color as the inspector of the Department of Agriculture may designate.

10. The inspector of the Department of Agriculture in charge of said establishment, being satisfied that the articles in said packages came from animals inspected by him, and that they are wholesome, sound, and fit for human food, shall affix to the top of said packages meat inspection stamps to be furnished by the Department of Agriculture, said stamps bearing serial numbers, and the inspector will write on said stamps the date of inspection.

The stamp must be securely affixed by paste and tacks in such a way as to be easily read when the package is standing on its bottom. Not less than five tacks shall be driven through each stamp, one at each corner and one in the middle of the stamp.

The stamp having been affixed it must be immediately cancelled. For this purpose the inspector will use a stencil plate of brass or copper, in which will be cut five parallel waved lines long enough to extend beyond each side of the stamp on the wood of the package. At the top of said stencil will be cut the name of the inspector and at the bottom of said stencil will be cut the district in which inspection is made. The imprinting from this plate must be with blacking or other durable material, over and across the stamp, and in such a manner as not to deface the reading matter on the stamp, that is, so as not to daub and make it illegible. The stamp having been affixed and cancelled, it must immediately be covered with a coating of transparent varnish or other substance. Orders for stamps must be made by the inspector on the chief of the Bureau of Animal Industry.

11. Whenever any package of meat products bearing the stamp of inspection shall have been opened and its contents removed for sale the stamp on said package must be effaced and obliterated from the package.

12. Reports of the work of inspection carried on in every establishment will be forwarded to the Department by the inspector in charge, on such blank forms and in such manner as will be specified in "Instructions to inspectors of slaughtering establishments."

SWINE.

13. The inspection of swine for export or interstate trade will be conducted in the same manner as prescribed in the foregoing rules, with the addition, however, that a microscopic examination for trichina will be required for all swine products.

14. When the slaughtered hog is passed into the cooling-room of said establishment, the veterinary inspector in charge, or his assistants, will take from each hog two samples of muscle, one from the "pillar of the diaphragm" and the other from another part of the body, and said samples will be put in a self-locking tin box and a numbered tag will be placed upon the hog from which said samples have been taken and a duplicate number of said tag will be placed in the box with said samples. The boxes containing the samples from the hogs in the cooling-room, so tagged, will be taken to the microscopist for such establishment, who shall thereupon make a microscopic examination of each box containing samples, and shall furnish a written report to the inspector in

charge of the cooling-room, giving the result of said microscopic examination together with the numbers of the hogs from which samples have been examined.

15. All hogs reported by the microscopist to the inspector in charge of the cooling-room to be affected with trichina will at once be removed from said cooling-room of said establishment under the supervision of said inspector or one of his deputies, and be disposed of by the owner in such manner as may be required by the laws of the State where said factory is situated.

16. The inspector in charge of the slaughtering or other establishment will issue a certificate of inspection for all carcasses of animals or the food products thereof which are to be exported into foreign countries, which certificate will cite the number of the factory, the name of the owner or owners operating the same, the date of inspection, and the name of the consignee and country to which said articles are to be exported. Said certificate will also contain the numbers of the stamps attached to the articles to be exported. One certificate only will be issued for each consignment. The certificates will be issued in serial numbers and in triplicate form. One copy thereof will be delivered to the consignor of such shipment, one copy will be attached to the invoice or shipping bill to accompany the same and be delivered by the transportation companies to the chief officer of the vessel upon which said consignment is to be transported, and the third copy will be forwarded to the Department of Agriculture for filing therein.

J. M. RUSK, *Secretary.*

AN ACT TO PROVIDE FOR THE INSPECTION OF LIVE CATTLE, HOGS, AND THE CARCASSES AND PRODUCTS THEREOF WHICH ARE THE SUBJECTS OF INTERSTATE COMMERCE, AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture shall cause to be made a careful inspection of all cattle intended for export to foreign countries from the United States, at such times and places, and in such manner, as he may think proper, with a view to ascertain whether such cattle are free from disease; and for this purpose he may appoint inspectors, who shall be authorized to give an official certificate clearly stating the condition in which such animals are found, and no clearance shall be given to any vessel having on board cattle for exportation to a foreign country unless the owner or shipper of such cattle has a certificate from the inspector herein authorized to be appointed, stating that said cattle are sound and free from disease.

SECT. 2. That the Secretary of Agriculture shall also cause to be made a careful inspection of all live cattle the meat of which is intended for exportation to any foreign country, at such times and places, and in such manner, as he may think proper, with a view to ascertain whether said cattle are free from disease and their meat sound and wholesome, and may appoint inspectors, who shall be authorized to give an official certificate clearly stating the condition in which such cattle and meat are found, and no clearance shall be given to any vessel having on board any fresh beef for exportation to and sale in a foreign country from any port of the United States until the owner or shipper shall obtain from an inspector appointed under the provisions of this act such certificate.

SECT. 3. The Secretary of Agriculture shall cause to be inspected prior to their slaughter, all cattle, sheep, and hogs which are subjects of interstate commerce and which are about to be slaughtered at slaughter-houses, canning, salting, packing or rendering establishments in any State or Territory, the carcasses or products of which are to be transported and sold for human consumption in any other State or Territory or the District of Columbia, and in addition to the aforesaid inspection, there may be made in all cases where the Secretary of Agriculture may deem necessary or expedient, under the rules and regulations to be by him prescribed, a post-mortem examination of the carcasses of all cattle, sheep, and hogs about to be prepared for human consumption at any slaughter-house, canning, salting, packing or rendering establishment in any State or Territory, or the District of Columbia, which are the subjects of interstate commerce.

SECT. 4. That said examination shall be made in the manner provided by rules and regulations to be prescribed by the Secretary of Agriculture, and after said examination the carcasses and products of all cattle, sheep, and swine found to be free of disease, and wholesome, sound, and fit for human food, shall be marked, stamped, or labelled for identification as may be provided by said rules and regulations of the Secretary of Agriculture.

Any person who shall forge, counterfeit, or knowingly and wrongfully alter, deface, or destroy any of the marks, stamps, or other devices provided for in the regulations of the Secretary of Agriculture, of any such carcasses or their products, or who shall forge, counterfeit, or knowingly and wrongfully alter, deface, or destroy any certificate provided for in said regulations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both said punishments in the discretion of the court.

Sect. 5. That it shall be unlawful for any person to transport from one State or Territory or the District of Columbia into any other State or Territory or the District of Columbia, or for any person to deliver to another for transportation from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia the carcasses of any cattle, sheep, or swine, or the food products thereof, which have been examined in accordance with the provisions of sections three and four of this act, and which on said examination have been declared by the inspector making the same to be unsound or diseased. Any person violating the provisions of this section shall be deemed guilty of a misdemeanor and punished for each offence as provided in section four of this act.

Sect. 6. That the inspectors provided for in sections one and two of this act shall be authorized to give official certificates of the sound and wholesome condition of the cattle, sheep, and swine, their carcasses and products described in sections three and four of this act, and one copy of every certificate granted under the provisions of this act shall be filed in the Department of Agriculture, another copy shall be delivered to the owner or shipper, and when the cattle, sheep, and swine, or their carcasses and products are sent abroad, a third copy shall be delivered to the chief officer of the vessel on which the shipment shall be made.

Sect. 7. That none of the provisions of this act shall be so construed as to apply to any cattle, sheep, or swine slaughtered by any farmer upon his farm, which may be transported from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia: *provided*, *however*, that if the carcasses of such cattle, sheep, or swine go to any packing or canning establishment and are intended for transportation to any other State or Territory or the District of Columbia, as hereinbefore provided, they shall there be subject to the post-mortem examination provided for in sections three and four of this act. [*Approved March 3*, *1891*.

MILK.

The whole number of samples of food examined during the year was 3,236, which was also greater than that of any previous year. This includes a considerable number of samples of milk of known purity, which will be referred to later on. The greatest amount of adulteration has been found in the more densely populated cities in the eastern part of the State. Among these cities Boston receives much greater protection from its local inspection than any of the other larger cities. Hence the work of the Board in this direction has been devoted more to other cities and large towns. Local inspectors have also depended largely upon the Board for the investigation of cases of milk adulteration, in which there was evidence that the actual offenders were beyond their jurisdiction, since it is by no means true that the retailer is invariably the guilty party.

The following summary comprises the results of the inspection of milk in the cities of eastern Massachusetts for the year ending Sept. 30, 1890. These samples were obtained from retailers, selling from wagons or shops.

Boston.

Number of samples received,	255
above standard,	144
below standard,	111
Skimmed,	4
Lowest sample (total solids),	9.53
Percentage below standard,	43.53

Worcester.

Number of samples received,	94
above standard,	50
below standard,	44
Skimmed,	1
Lowest sample (total solids),	11.52
Percentage below standard,	46.81

Lowell.

Number of samples received,	136
above standard,	85
below standard,	51
Skimmed,	3
Lowest,	9.54
Percentage below standard,	37.50

Fall River.

Number of samples received;	26
above standard,	20
below standard,	6
Lowest,	11.02
Percentage below standard,	23.07

Cambridge.

Number of samples received,	229
above standard,	93
below standard,	136
Skimmed,	2
Lowest,	10.07
Percentage below standard,	59.39

Lynn.

Number of samples received,	73
above standard,	29
below standard,	44
Lowest,	10.60
Percentage below standard,	60.27

Lawrence.

Number of samples received,	118
above standard,	67
below standard,	51
Skimmed,	4
Lowest,	11.40
Percentage below standard,	43.22

New Bedford.

Number of samples received,	14
above standard,	9
below standard,	5
Lowest,	11.90
Percentage below standard,	35.71

Somerville.

Number of samples received,	73
above standard,	26
below standard,	47
Lowest,	10.41
Percentage below standard,	64.38

Salem.

Number of samples received,	71
above standard,	39
below standard,	32
Lowest,	11.15
Percentage below standard,	45.07

Chelsea.

Number of samples received,	69
above standard,	40
below standard,	29
Lowest,	11.24
Percentage below standard,	42.03

Haverhill.

Number of samples received,	84
above standard,	43
below standard,	41
Lowest,	11.06
Percentage below standard,	48.81

Brockton.

Number of samples received,	12
above standard,	8
below standard,	4
Lowest,	11.67
Percentage below standard,	33.33

Taunton.

Number of samples received,	59
above standard,	39
below standard,	20
Lowest,	10.96
Percentage below standard,	33.89

Newton.

Number of samples received,	73
above standard,	46
below standard,	27
Lowest,	11.00
Percentage below standard,	36.98

Malden.

Number of samples received,	21
above standard,	4
below standard,	17
Lowest,	10.81
Percentage below standard,	80.95

Fitchburg.

Number of samples received,	11
above standard,	3
below standard,	8
Lowest,	10.76
Percentage below standard,	72.72

Gloucester.

Number of samples received,	25
above standard,	16
below standard,	9
Lowest,	12.08
Percentage below standard,	36.00

Waltham.

Number of samples received,	47
above standard,	23
below standard,	24
Skimmed,	1
Lowest,	10.65
Percentage below standard,	51.06

Quincy.

Number of samples received,	70
above standard,	43
below standard,	27
Skimmed,	1
Lowest,	10.10
Percentage below standard,	38.57

Newburyport.

Number of samples received,	26
above standard,	23
below standard,	3
Lowest,	12.02
Percentage below standard,	11.54

Marlborough.

Number of samples received,	53
above standard,	35
below standard,	18
Skimmed,	2
Lowest,	10.20
Percentage below standard,	33.96

Woburn.

Number of samples received,	23
above standard,	14
below standard,	9
Lowest,	11.81
Percentage below standard,	39.13

Summary.

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.
Boston,	255	144	111	43.53	4
Worcester,	94	50	44	46.81	1
Lowell,	136	85	51	37.50	3
Fall River,	26	20	6	23.07	–
Cambridge,	229	93	136	59.39	2
Lynn,	73	29	44	60.27	–
Lawrence,	118	67	51	43.22	4
New Bedford,	14	9	5	35.71	–
Somerville,	73	26	47	64.38	–
Salem,	71	39	32	45.07	–
Chelsea,	69	40	29	42.03	–
Haverhill,	84	43	41	48.81	–
Brockton,	12	8	4	33.33	–
Taunton,	59	39	20	33.89	–
Newton,	73	46	27	36.98	–
Malden,	21	4	17	80.95	–
Fitchburg,	11	3	8	72.72	–
Gloucester,	25	16	9	36.00	–
Waltham,	47	23	24	51.06	1
Quincy,	70	43	27	38.57	1
Newburyport,	26	23	3	11.54	–
Marlborough,	53	35	18	33.96	2
Woburn,	23	14	9	39.13	–
	1,662	899	763	45.90	18

Milk of Known Purity.

During the few years in which the Board has been intrusted with the duty of carrying out the provisions of the statutes, it has devoted a share of its attention to the work of "investigations and inquiries" with reference to the subject of natural milk as obtained direct from the cow, or milk of "known purity." The milk of at least eight hundred animals has thus been subjected to analysis. These observations were made under all the varying conditions of different breeds, ages, seasons of the year, time of day and feeding. The averages of all these samples of milk differed but little from thirteen and one-fourth per cent. of total solids. Thus the majority of the samples yielded an average which was above the legal standard, while a very considerable percentage ranged from twelve to thirteen per cent. of solids. It is rare to find a herd of ten or more cows, well fed and of different breeds, in which the average milk of the herd falls below twelve and one-half per cent. of solids, and still more rare to find a herd the average milk of which has less than twelve per cent.

The principal disturbing element has been the Holstein cow. Just what processes have been adopted in past generations among the Channel Islands to produce a breed of animals which yield a rich and nutritious milk, and in a neighboring country to produce a breed which furnish an impoverished product, it may not be possible to affirm. It is true, however, that the Holstein cow does not yield an average milk which contains thirteen per cent. of total solids. If the necessary result of the execution of the milk laws in Massachusetts is a diminution of the number of Holstein cows, the consumer certainly profits thereby, if not the producer.

The milk of forty-seven Holstein cows examined in 1885 was found to contain an average of 12.51 per cent. of total solids. The milk of eleven Jersey cows examined in the same year was found to contain an average of 14.02 per cent. of solids.

During the past year investigations were made to ascertain what variations the milk of a good average herd of dairy cattle would present throughout the different seasons of the year. A herd of sixteen cows in Weston, Middlesex County, was selected, and milk obtained from each animal in this herd once a month throughout the year 1890, with the following result.

As is commonly the custom in dairy farms, where constant changes are occurring, consisting in the buying of new animals to supply the place of others which have been sold for various purposes, several changes were made in this herd, which are indicated.

Each of the first sixteen cows in this list received fourteen quarts of brewers' grains daily, and in addition Nos. 1, 2, 3, 4, 5, 8, 14 and 16 each received one quart of corn meal and one quart of oil meal daily; Nos. 6, 7, 9, 10 and 15 each received two quarts of corn meal and one quart of oil meal; Nos. 11 and 12 had three quarts corn meal and one quart oil meal; No. 13 had four quarts corn meal and one quart oil meal. One-half of this feed was given at morning and one-half at night. They were also given coarse English hay in the morning, watered, and then fed with oat and barley fodder. At four o'clock P.M. they were fed with rowen, watered, grained and then fed with meadow hay. The daily ration of hay to each cow was about fourteen pounds.

No. 1. Grade Ayrshire; five years old; calved in October, 1889; yields seven quarts per day.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Jan. 29, 1890, 5.15 P.M.,	4.09	11.30	15.39	84.61
Feb. 26, 1890, 5.15 P.M.,	4.10	11.22	15.32	84.68
Mar. 26, 1890, 6.15 P.M.,	4.11	11.03	15.14	84.86
Mar. 27, 1890, 6.30 A.M.,	4.47	11.30	15.77	84.23
April 30, 1890, 6.00 P.M.,	4.91	11.95	16.86	83.14
Nov. 26, 1890, 6.00 P.M.,	3.57	9.94	13.51	86.49
Dec. 31, 1890, 6.00 P.M.,	3.03	9.99	13.02	86.98
Jan. 1, 1891, 6.00 A.M.,	3.70	10.28	13.98	86.02
AVERAGE,	4.00	10.87	14.87	85.13

No. 2. Grade Guernsey; four years old; calved in September, 1889; yields seven quarts per day.

Jan. 29, 1890, 5.15 P.M.,	4.32	10.54	14.86	85.14
Feb. 26, 1890, 5.15 P.M.,	4.77	10.48	15.25	84.75
Mar. 26, 1890, 6.15 P.M.,	5.07	10.49	15.56	84.44
Mar. 27, 1890, 6.30 A.M.,	4.76	10.60	15.36	84.64
April 30, 1890, 6.00 P.M.,	4.56	10.18	14.74	85.26
Oct. 29, 1890, 6.00 P.M.,	3.74	10.08	13.82	86.18
Nov. 26, 1890, 6.00 P.M.,	2.91	10.22	13.13	86.87
Dec. 31, 1890, 6.00 P.M.,	4.91	10.15	15.06	84.94
Jan. 1, 1891, 6.00 A.M.,	4.54	9.86	14.40	85.60
AVERAGE,	4.40	10.29	14.69	85.31

No. 3. Grade Holstein; six years old; calved in September, 1889; yields six quarts per day.

Jan. 29, 1890, 5.15 P.M.,	4.46	11.29	15.75	84.25
Feb. 26, 1890, 5.15 P.M.,	4.31	11.12	15.43	84.57
Mar. 26, 1890, 6.15 P.M.,	4.62	10.55	15.17	84.83
Mar. 27, 1890, 6.30 A.M.,	4.64	10.79	15.43	84.57
April 30, 1890, 6.00 P.M.,	4.29	10.54	14.83	85.17
Oct. 29, 1890, 6.00 P.M.,	4.28	10.23	14.51	85.49
Nov. 26, 1890, 6.00 P.M.,	3.74	9.91	13.65	86.35
Dec. 31, 1890, 6.00 P.M.,	4.64	10.22	14.86	85.14
Jan. 1, 1891, 6.00 A.M.,	4.95	10.17	15.12	84.88
AVERAGE,	4.44	10.53	14.97	85.03

No. 4. Grade Holstein; five years old; calved in September, 1889; yields six quarts per day.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Jan. 29, 1890, 5.15 P.M.,	3.95	10.34	14.29	85.71
Feb. 26, 1890, 5.15 P.M.,	3.96	10.50	14.46	85.54
Mar. 26, 1890, 6.15 P.M.,	3.71	10.08	13.79	86.21
Mar. 27, 1890, 6.30 A.M.,	3.86	9.87	13.73	86.27
April 30, 1890, 6.00 P.M.,	4.14	9.72	13.86	86.14
May 28, 1890, 6.00 P.M.,	3.55	9.70	13.25	86.75
June 25, 1890, 6.00 P.M.,	2.51	9.90	12.41	87.59
June 26, 1890, 6.00 A.M.,	4.17	9.48	13.65	86.35
July 30, 1890, 6.00 P.M.,	4.42	8.92	13.34	86.66
Aug. 27, 1890, 6.00 P.M.,	3.47	9.12	12.59	87.41
Sept. 24, 1890, 6.00 P.M.,	3.21	10.47	13.68	86.32
Sept. 25, 1890, 6.00 A.M.,	4.61	9.93	14.54	85.46
Oct. 29, 1890, 6.00 P.M.,	3.78	10.16	13.94	86.06
AVERAGE,	3.80	9.86	13.66	86.34

No. 5. Grade Ayrshire; nine years old; calved in February, 1889; yields nine quarts per day.

Jan. 29, 1890, 5.15 P.M.,	3.84	11.21	15.05	84.95
Feb. 26, 1890, 5.15 P.M.,	4.44	10.68	15.12	84.88
Mar. 26, 1890, 6.15 P.M.,	3.86	10.75	14.61	85.39
Mar. 27, 1890, 6.30 A.M.,	fat	lost	14.30	85.70
April 30, 1890, 6.00 P.M.,	4.40	9.88	14.28	85.72
Aug. 27, 1890, 6.00 P.M.,	3.74	9.30	13.04	86.96
Sept. 24, 1890, 6.00 P.M.,	3.62	9.67	13.29	86.71
Sept. 25, 1890, 6.00 A.M.,	3.15	10.05	13.20	86.80
Oct. 29, 1890, 6.00 P.M.,	3.35	10.01	13.36	86.64
Nov. 26, 1890, 6.00 P.M.,	3.52	10.27	13.79	86.21
Dec. 31, 1890, 6.00 P.M.,	4.12	10.43	14.55	85.45
Jan. 1, 1891, 6.00 A.M.,	4.51	10.41	14.92	85.08
AVERAGE,	3.87	10.24	14.12	85.88

No. 6. Grade Ayrshire; twelve years old; calved in May, 1889; yields nine quarts per day.

Jan. 29, 1890, 5.15 P.M.,	3.95	10.46	14.41	85.59
Feb. 26, 1890, 5.15 P.M.,	4.13	10.33	14.46	85.54
Mar. 26, 1890, 6.15 P.M.,	3.77	10.10	13.87	86.13
Mar. 27, 1890, 6.30 A.M.,	3.48	10.20	13.68	86.32
April 30, 1890, 6.00 P.M.,	3.77	9.99	13.76	86.24
May 28, 1890, 6.00 P.M.,	3.42	9.98	13.40	86.60
June 25, 1890, 6.00 P.M.,	2.72	9.47	12.19	87.81
June 26, 1890, 6.00 A.M.,	4.57	9.35	13.92	86.08
July 30, 1890, 6.00 P.M.,	3.62	9.37	12.99	87.01
Aug. 27, 1890, 6.00 P.M.,	3.51	9.84	13.35	86.65
Sept. 24, 1890, 6.00 P.M.,	2.67	10.71	13.38	86.62
Sept. 25, 1890, 6.00 A.M.,	3.86	10.43	14.29	85.71
Oct. 29, 1890, 6.00 P.M.,	3.80	10.60	14.40	85.60
Nov. 26, 1890, 6.00 P.M.,	2.97	10.05	13.02	86.98
AVERAGE,	3.59	10.06	13.65	86.35

No. 7. Holstein; five years old; calved in December, 1889; yields fourteen quarts per day.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
Jan. 29, 1890, 5.15 P.M.,	3.83	8.06	11.89	88.11
Feb. 26, 1890, 5.15 P.M.,	2.40	9.56	11.96	88.04
Mar. 26, 1890, 6.15 P.M.,	2.62	9.22	11.84	88.16
Mar. 27, 1890, 6.30 A.M.,	2.33	9.17	11.50	88.50
April 30, 1890, 6.00 P.M.,	3.03	9.23	12.26	87.74
May 28, 1890, 6.00 P.M.,	3.07	9.45	12.52	87.48
June 25, 1890, 6.00 P.M.,	2.95	9.24	12.19	87.81
June 26, 1890, 6.00 A.M.,	2.94	9.21	12.15	87.85
July 30, 1890, 6.00 P.M.,	2.44	9.23	11.67	88.33
Aug. 27, 1890, 6.00 P.M.,	2.86	9.57	12.43	87.57
Sept. 24, 1890, 6.00 P.M.,	3.54	9.33	12.87	87.13
Sept. 25, 1890, 6.00 A.M.,	3.41	9.65	13.06	86.94
Oct. 29, 1890, 6.00 P.M.,	3.15	10.05	13.20	86.80
Nov. 26, 1890, 6.00 P.M.,	2.59	10.04	12.63	87.37
Dec. 31, 1890, 6.00 P.M.,	2.73	10.03	12.76	87.24
Jan. 1, 1891, 6.00 A.M.,	3.12	9.70	12.82	87.18
Average,	2.94	9.42	12.36	87.64

No. 8. Grade Ayrshire; nine years old; calved in September, 1889; yields seven quarts per day.

Jan. 29, 1890, 5.15 P.M.,	3.16	9.84	13.00	87.00
Feb. 26, 1890, 5.15 P.M.,	3.41	9.97	13.38	86.62
Mar. 26, 1890, 6.15 P.M.,	3.52	9.90	13.42	86.58
Mar. 28, 1890, 6.30 A.M.,	3.43	9.80	13.23	86.77
April 30, 1890, 6.00 P.M.,	4.14	9.71	13.85	86.15
Aug. 27, 1890, 6.00 P.M.,	3.08	9.27	12.35	87.65
Sept. 24, 1890, 6.00 P.M.,	3.58	9.44	13.02	86.98
Sept. 25, 1890, 6.00 A.M.,	2.97	9.76	12.73	87.27
Oct. 29, 1890, 6.00 P.M.,	3.54	9.77	13.31	86.69
Nov. 26, 1890, 6.00 P.M.,	2.84	9.87	13.71	86.29
Dec. 31, 1890, 6.00 P.M.,	3.15	9.95	13.10	86.90
Jan. 1, 1891, 6.00 A.M.,	3.66	9.82	13.48	86.52
Average,	3.45	9.76	13.21	86.79

No. 9. Grade Holstein; four years old; calved in December, 1889; yields seven quarts per day.

Jan. 29, 1890, 5.15 P.M.,	3.79	10.12	13.91	86.09
Feb. 26, 1890, 5.15 P.M.,	3.52	10.42	13.94	86.06
Mar. 26, 1890, 6.15 P.M.,	3.36	10.37	13.73	86.27
Mar. 27, 1890, 6.30 A.M.,	4.43	10.13	14.56	85.44
April 30, 1890, 6.00 P.M.,	3.82	10.45	14.27	85.73
May 28, 1890, 6.00 P.M.,	3.94	10.48	14.42	85.58
June 25, 1890, 6.00 P.M.,	3.84	10.00	13.84	86.16
June 26, 1890, 6.00 A.M.,	4.59	10.19	14.78	85.22
July 30, 1890, 6.00 P.M.,	2.69	10.26	12.95	87.05
Aug. 27, 1890, 6.00 P.M.,	4.05	9.98	14.03	85.97
Sept. 24, 1890, 6.00 P.M.,	4.03	10.76	14.79	85.21
Sept. 25, 1890, 6.00 A.M.,	6.27	10.79	17.06	82.94
Average,	4.03	10.33	14.36	85.64

No. 10. Grade Ayrshire; eight years old; calved in October, 1889; yields eleven quarts per day.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
Jan. 29, 1890, 5.15 P.M., . .	4.02	10.45	14.47	85.53
Feb. 26, 1890, 5.15 P.M., . .	2.69	11.54	14.23	85.77
Mar 26, 1890, 6.15 P.M., . .	3.38	10.17	13.55	86.45
Mar. 27, 1890, 6.30 A.M., . .	3.37	10.02	13.39	86.61
April 30, 1890, 6.00 P.M., . .	3.88	10.28	14.16	85.84
May 28, 1890, 6.00 P.M., . .	3.61	9.75	13.36	86.64
June 25, 1890, 6.00 P.M., . .	4.13	9.60	13.73	86.27
June 26, 1890, 6.00 A.M., . .	4.64	9.91	14.55	85.45
July 30, 1890, 6.00 P.M., . .	2.99	9.60	12.59	87.41
Aug. 27, 1890, 6.00 P.M., . .	3.42	9.76	13.18	86.82
Sept. 24, 1890, 6.00 P.M., . .	4.36	10.39	14.75	85.25
Sept. 25, 1890, 6.00 A.M., . .	5.34	9.97	15.31	84.69
Oct. 29, 1890, 6.00 P.M., . .	3.89	10.90	14.79	85.21
Nov. 26, 1890, 6.00 P.M., . .	5.12	11.46	16.58	83.42
Dec. 31, 1890, 6.00 P.M., . .	4.51	11.08	15.59	84.41
Jan. 1, 1891, 6.00 P.M., . .	4.56	11.12	15.68	84.32
AVERAGE, ...	3.99	10.38	14.37	85.63

No. 11. Grade Holstein; nine years old; calved in September, 1889; yields fourteen quarts per day.

Jan. 29, 1890, 5.15 P.M., . .	5.06	10.16	15.22	84.78
Feb. 26, 1890, 5.15 P.M., . .	5.11	10.11	15.22	84.78
Mar. 26, 1890, 6.15 P.M., . .	3.79	10.06	13.85	86.15
Mar. 27, 1890, 6.30 A.M., . .	2.95	10.19	13.14	86.46
April 30, 1890, 6.00 P.M., . .	4.70	10.03	14.73	85.27
May 28, 1890, 6.00 P.M., . .	3.85	10.05	13.90	86.10
June 25, 1890, 6.00 P.M., . .	–	–	–	–
June 26, 1890, 6.00 A.M., . .	4.68	9.54	14.22	85.78
July 30, 1890, 6.00 P.M., . .	4.34	10.22	14.56	85.44
Aug. 27, 1890, 6.00 P.M., . .	4.00	9.85	13.85	86.15
Sept. 24, 1890, 6.00 P.M., . .	5.33	10.29	15.62	84.38
Sept. 25, 1890, ...	–	–	–	–
Oct. 29, 1890, 6.00 P.M., . .	4.98	10.99	15.97	84.03
Nov. 26, 1890, 6.00 P.M., . .	3.40	9.38	12.78	87.22
Dec. 31, 1890, 6.00 P.M., . .	5.31	11.40	16.71	83.29
Jan. 1, 1891, 6.00 A.M., . .	5.45	10.84	16.29	83.71
AVERAGE, ...	4.50	10.22	14.72	85.28

No. 12. Grade Ayrshire; eight years old; calved in November, 1889; yields fourteen quarts per day.

Jan. 29, 1890, 5.15 P.M., . .	3.41	10.00	13.41	86.59
Feb. 26, 1890, 5.15 P.M., . .	3.37	9.91	13.28	86.72
Mar. 26, 1890, 6.15 P.M., . .	3.30	9.94	13.24	86.76
Mar. 27, 1890, 6.30 A.M., . .	4.16	10.04	14.20	85.80
April 30, 1890, 6.00 P.M., . .	4.21	9.82	14.03	85.97
May 28, 1890, 6.00 P.M., . .	3.72	10.08	13.80	86.20
June 25, 1890, 6.00 P.M., . .	2.98	10.01	12.99	87.01

No. 12. Grade Ayrshire; eight years old; calved in November, 1889; yields fourteen quarts per day — Concluded.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
June 26, 1890, 6.00 A.M., . .	4.78	9.37	14.15	85.85
July 30, 1890, 6.00 P.M., . .	3.53	9.69	13.22	86.78
Aug. 27, 1890, 6.00 P.M., . .	3.96	9.53	13.49	86.51
Sept. 24, 1890, 6.00 P.M., . .	4.03	10.90	14.93	85.07
Sept. 25, 1890, 6.00 A.M., . .	3.08	9.05	12.13	87.87
Average, ...	3.71	9.86	13.57	86.43

No. 13. Grade Durham and Ayrshire; seven years old; calved in October, 1889; yields twenty quarts per day.

Jan. 29, 1890, 5.15 P.M., . .	2.80	9.61	12.41	87.59
Feb. 26, 1890, 5.15 P.M., . .	2.93	9.74	12.67	87.33
Mar. 26, 1890, 6.15 P.M., . .	2.86	9.48	12.34	87.66
Mar. 27, 1890, 6.30 A.M., . .	3.29	9.30	12.59	87.41
April 30, 1890, 6.00 P.M., . .	3.31	9.46	12.77	87.23
May 28, 1890, 6.00 P.M., . .	2.04	9.60	11.64	88.36
June 25, 1890, 6.00 P.M., . .	2.69	9.16	11.85	88.15
June 26, 1890, 6.00 A.M., . .	3.06	9.07	12.13	87.87
July 30, 1890, 6.00 P.M., . .	2.66	9.18	11.84	88.16
Aug. 27, 1890, 6.00 P.M., . .	3.36	8.58	11.94	88.06
Sept. 24, 1890, 6.00 P.M., . .	3.19	9.27	12.46	87.54
Sept. 25, 1890, 6.00 A.M., . .	3.52	8.99	12.51	87.49
Oct. 29, 1890, 6.00 P.M., . .	3.03	9.59	12.62	87.38
Nov. 26, 1890, 6.00 P.M., . .	4.80	10.27	15.07	84.93
Dec. 31, 1890, 6.00 P.M., . .	3.71	9.90	13.61	86.39
Jan. 1, 1891, 6.00 A.M., . .	3.88	9.90	13.78	86.22
Average, ...	3.20	9.44	12.64	87.36

No. 14. Grade Jersey; eleven years old; calved in March, 1889; yields six quarts per day.

Jan. 29, 1890, 5.15 P.M., . .	3.49	9.76	13.25	86.75
Feb. 26, 1890, 5.15 P.M., . .	4.57	9.81	14.38	85.62
Mar. 26, 1890, 6.15 P.M., . .	4.20	9.83	14.03	85.97
Mar. 27, 1890, 6.30 A.M., . .	4.54	9.69	14.23	85.77
April 30, 1890, 6.00 P.M., . .	5.05	9.48	14.53	85.47
May 28, 1890, 6.00 P.M., . .	4.44	9.91	14.35	85.65
June 25, 1890, 6.00 P.M., . .	4.04	9.53	13.57	86.43
June 26, 1890, 6.00 A.M., . .	4.69	9.56	14.25	85.75
July 30, 1890, 6.00 P.M., . .	4.31	10.22	14.53	85.47
Aug. 27, 1890, 6.00 P.M., . .	5.86	10.31	16.17	83.83
Sept. 24, 1890, 6.00 P.M., . .	4.82	10.19	15.01	84.99
Sept. 25, 1890, 6.00 A.M., . .	5.54	10.19	15.73	84.27
Oct. 29, 1890, 6.00 P.M., . .	6.48	9.21	15.69	84.31
Nov. 26, 1890, 6.00 P.M., . .	3.34	9.24	12.58	87.42
Dec. 31, 1890, 6.00 P.M., . .	4.80	10.30	15.10	84.90
Jan. 1, 1891, 6.00 A.M., . .	4.68	10.15	14.83	85.17
Average, ...	4.68	9.83	14.51	85.49

No. 15. Grade Holstein; seven years old; calved in September, 1889; yields ten quarts per day.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Jan. 29, 1890, 5.15 P.M.,	3.50	9.70	13.20	86.80
Feb. 26, 1890, 5.15 P.M.,	3.96	9.79	13.75	86.25
Mar. 26, 1890, 6.15 P.M.,	3.71	9.44	13.15	86.85
Mar. 27, 1890, 6.30 A.M.,	3.28	9.61	12.89	87.11
April 30, 1890, 6.00 P.M.,	3.62	9.23	12.85	87.15
May 28, 1890, 6.00 P.M.,	3.78	9.31	13.09	86.91
June 25, 1890, 6.00 P.M.,	3.36	9.45	12.81	87.19
June 26, 1890, 6.00 A.M.,	4.02	9.47	13.49	86.51
July 30, 1890, 6.00 P.M.,	3.51	9.77	13.28	86.72
Nov. 26, 1890, 6.00 P.M.,	3.10	9.74	12.84	87.16
Dec. 31, 1890, 6.00 P.M.,	3.15	9.67	12.82	87.18
Jan. 1, 1891, 6.00 A.M.,	3.59	9.87	13.46	86.54
AVERAGE,	3.54	9.59	13.13	86.87

No. 16. Grade; nine years old; calved in January, 1889; yields seven quarts per day.

Jan. 29, 1890, 5.15 P.M.,	2.10	10.51	12.61	87.39
Feb. 26, 1890, 5.15 P.M.,	3.18	10.22	13.40	86.60
Mar. 26, 1890, 6.15 P.M.,	2.90	10.62	13.52	86.48
Mar. 27, 1890, 6.30 A.M.,	3.36	10.18	13.54	86.46
Oct. 29, 1890, 6.00 P.M.,	4.25	9.61	13.86	86.14
Nov. 26, 1890, 6.00 P.M.,	1.64	11.73	13.37	86.63
Dec. 31, 1890, 6.00 P.M.,	3.05	10.02	13.07	86.93
Jan. 1, 1891, 6.00 A.M.,	3.75	9.72	13.47	86.53
AVERAGE,	3.03	10.32	13.35	86.65

No. 17.

April 30, 1890, 6.00 P.M.,	3.05	9.44	12.49	87.51
May 28, 1890, 6.00 P.M.,	2.11	9.30	11.41	88.59
June 25, 1890, 6.00 P.M.,	1.98	9.63	11.61	88.39
June 26, 1890, 6.00 A.M.,	3.54	9.35	12.89	87.11
July 30, 1890, 6.00 P.M.,	2.18	9.13	11.31	88.69
Aug. 27, 1890, 6.00 P.M.,	2.54	9.21	11.75	88.25
Sept 24, 1890, 6.00 P.M.,	3.28	9.07	12.35	87.65
Sept. 25, 1890, 6.00 A.M.,	3.48	8.99	12.47	87.53
Oct. 29, 1890, 6.00 P.M.,	3.07	9.77	12.84	87.16
Nov. 26, 1890, 6.00 P.M.,	3.25	10.96	14.21	85.79
Dec. 31, 1890, 6.00 P.M.,	3.30	10.33	13.63	86.37
Jan. 1, 1891, 6.00 A.M.,	3.42	10.23	13.65	86.35
AVERAGE,	2.93	9.62	12.55	87.45

No. 18. Dutch; four or five years old; calved in April, 1890; yields fourteen quarts per day.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
May. 28, 1890, 6.00 P.M.,	2.92	9.42	12.34	87.66
June 25, 1890, 6.00 P.M.,	3.16	9.29	12.45	87.55
June 26, 1890, 6.00 A.M ,	3.64	9.17	12.81	87.19
July 30, 1890, 6.00 P.M.,	2.87	9.17	12.04	87.96
Aug. 27, 1890, 6.00 P.M ,	3.53	9.24	12.77	87.23
Sept. 24, 1890, 6.00 P.M.,	3.49	9.30	12.79	87.21
Sept. 25, 1890, 6.00 A.M.,	3.68	9.80	13.48	86.52
Oct. 29, 1890, 6.00 P.M.,	4.59	9.97	14.56	85.44
Nov. 26, 1890, 6.00 P.M ,	2.47	9.35	11.82	88.18
Dec 31, 1890, 6.00 P.M.,	3.99	10.54	14.53	85.47
Jan. 1, 1891, 6.00 A.M.,	3.87	10.60	14.47	85.53
AVERAGE,	3.47	9.62	13.09	86.91

No 19. Native, partly Ayrshire; seven years old; calved in April, 1890; yields fifteen quarts per day.

May 28, 1890, 6.00 P.M ,	3.38	9.47	12.85	87.15
June 25, 1890, 6.00 P.M.,	2.49	8.85	11.34	88.66
June 26, 1890, 6.00 A M.,	2.36	9.33	11.69	88.31
July 30, 1890, 6.00 P.M ,	4.06	8.49	12.55	87.45
Aug. 27, 1890, 6.00 P.M ,	3.11	8.63	11.74	88.26
Sept. 24, 1890, 6.00 P.M ,	2.67	9.12	11.79	88.21
Sept. 25, 1890, 6.00 A.M.,	5.28	10.71	15.99	84.01
Oct. 29, 1890, 6.00 P.M.,	2.84	9.49	12.33	87.67
Nov. 26, 1890, 6.00 P.M.,	5.22	11.40	16.62	83.38
Dec. 31, 1890, 6.00 P.M.,	2.07	9.56	11.63	88.37
Jan. 1, 1891, 6.00 A.M.,	2.33	9.62	11.95	88.05
AVERAGE,	3.26	9.51	12.77	87.23

No. 20. Dutch; three years old; calved in April, 1890; yields eleven quarts per day.

May 28, 1890, 6.00 P M.,	2.51	9.54	12.05	87.95
June 25, 1890, 6.00 P.M.,	2.55	9.29	11.84	88.16
June 26, 1890, 6.00 A.M.,	3.95	9.11	13.06	86.94
July 30, 1890, 6.00 P M.,	2.96	8.94	11.90	88.10
Aug. 27, 1890, 6.00 P.M.,	3.32	8.97	12.29	87.71
Sept. 24, 1890, 6.00 P.M.,	3.24	8.93	12.17	87.83
Sept. 25, 1890, 6.00 A.M.,	3.42	9.21	12.63	87.37
Oct. 29, 1890, 6.00 P.M.,	3.62	9.57	13.19	86.81
Dec. 31, 1890, 6.00 P.M.,	3.06	9.60	12.66	87.34
Jan. 1, 1891, 6.00 A.M.,	2.94	9.93	12.87	87.13
AVERAGE,	3.16	9.31	12.47	87.53

No. 21. Native; five years old; calved in April, 1890; yields eight quarts per day.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M.,	3.94	9.69	13.63	86.37
June 25, 1890, 6.00 P.M.,	3.87	9.73	13.60	86.40
June 26, 1890, 6.00 A.M.,	3.88	9.57	13.45	86.55
July 30, 1890, 6.00 P.M.,	3.09	9.07	12.16	87.84
Aug. 27, 1890, 6.00 P.M.,	3.59	9.07	12.66	87.34
Sept. 24, 1890, 6.00 P.M.,	3.88	9.12	13.00	87.00
Sept. 25, 1890, 6.00 A.M.,	4.03	9.76	13.79	86.21
Average,	3.75	9.43	13.18	86.82

No. 22. Native; twelve years old; calved in April; yields eight quarts per day.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M.,	2.73	9.44	12.17	87.83
June 25, 1890, 6.00 P.M.,	2.55	9.42	11.97	88.03
June 26, 1890, 6.00 A.M.,	3.26	9.15	12.41	87.59
July 30, 1890, 6.00 P.M.,	2.42	9.72	12.14	87.86
Average,	2.74	9.43	12.17	87.83

The following analyses were also made of the milk of another herd of cows, also in the town of Weston, the analyses being made once in each quarter of the year, — in May, August, November and February.

No. 1. Mixed; eight years old.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M.,	3.25	9.58	12.83	87.17
Aug. 27, 1890, 6.00 P.M.,	3.99	9.34	13.33	86.67
Nov. 26, 1890, 6.00 P.M.,	3.91	9.93	13.84	86.16
Average,	3.71	9.62	13.33	86.67

No. 2. Mixed; eight years old.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M.,	3.54	9.96	13.50	86.50
Aug. 27, 1890, 6.00 P.M.,	4.53	9.72	14.25	85.75
Average,	4.03	9.84	13.87	86.13

No. 3. Dutch; eleven years old.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M., . .	3.31	9.72	13.03	86.97

No. 4. Ayrshire; ten years old.

May 28, 1890, 6.00 P.M., . .	3.72	9.48	13.20	86.80
Aug. 27, 1890, 6.00 P.M., . .	3.67	9.79	13.46	86.54
Nov. 26, 1890, 6.00 P.M., . .	4.33	10.18	14.51	85.49
AVERAGE, ...	3.90	9.82	13.72	86.28

No. 5. Ayrshire; eight years old.

May 28, 1890, 6.00 P.M., . .	2.53	10.00	12.53	87.47
Aug. 27, 1890, 6.00 P.M., . .	3.89	9.27	13.16	86.84
AVERAGE, ...	3.21	9.63	12.84	87.16

No. 6. Devon; twelve years old.

May 28, 1890, 6.00 P.M., . .	2.83	10.20	13.03	86.97
Aug. 27, 1890, 6.00 P.M., . .	2.96	9.66	12.62	87.38
AVERAGE, ...	2.89	9.93	12.82	87.18

No. 7. Devon; three years old.

May 28, 1890, 6.00 P.M., . .	3.84	10.01	13.85	86.15
Aug. 27, 1890, 6.00 P.M., . .	4.09	10.21	14.30	85.70
Nov. 26, 1890, 6.00 P.M., . .	4.60	10.56	15.16	84.84
Feb. 25, 1891, 5.00 P.M., . .	3.37	10.05	13.42	86.58
AVERAGE, ...	3.97	10.21	14.18	85.82

No. 8. Mixed; five years old.

May 28, 1890, 6.00 P.M., . .	4.07	9.79	13.86	86.14

No. 9. Holstein; six years old.

May 28, 1890, 6.00 P.M., . .	3.76	9.24	13.00	87.00
Aug. 27, 1890, 6.00 P.M., . .	2.51	9.63	12.14	87.86
Nov. 26, 1890, 6.00 P.M., . .	4.28	9.97	14.25	85.75
AVERAGE, ...	3.52	9.61	13.13	86.87

No. 10. Mixed; six years old.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M., . .	3.15	9.33	12.48	87.52
Aug. 27, 1890, 6.00 P.M., . .	3.71	9.70	13.41	86.59
Feb. 25, 1891, 5.00 P.M., . .	3.85	9.18	13.03	86.97
AVERAGE, ...	3.57	9.40	12.97	87.03

No. 11. Mixed; seven years old.

May 28, 1890, 6.00 P.M., . .	3.17	10.26	13.43	86.57
Aug. 27, 1890, 6.00 P.M., . .	2.88	10.22	13.10	86.90
AVERAGE, ...	3.02	10.24	13.26	87.74

No. 12. Mixed; twelve years old.

May 28, 1890, 6.00 P.M., . .	3.29	10.02	13.31	86.69
Nov. 26, 1890, 6.00 P.M., . .	3.35	9.90	13.25	86.75
Feb. 25, 1891, 5.00 P.M., . .	2.98	9.73	12.71	87.29
AVERAGE, ...	3.21	9.88	13.09	86.91

No. 13. Mixed; six years old.

May 28, 1890, 6.00 P.M., . .	2.74	10.12	12.86	87.14
Nov. 26, 1890, 6.00 P.M., . .	3.59	10.42	14.01	85.99
Feb. 26, 1891, 5.00 P.M., . .	2.98	9.97	12.95	87.05
AVERAGE, ...	3.10	10.17	13.27	86.73

No. 14. Mixed; six years old.

May 28, 1890, 6.00 P.M., . .	3.85	11.26	15.11	84.89
Nov. 26, 1890, 6.00 P.M., . .	2.93	9.56	12.49	87.51
Feb. 26, 1891, 5.00 P.M., . .	3.13	9.77	12.90	87.10
AVERAGE, ...	3.30	10.20	13.50	86.50

No. 15. Mixed; five years old.

May 28, 1890, 6.00 P.M., . .	4.09	9.86	13.95	86.05
Aug. 27, 1890, 6.00 P.M., . .	3.61	10.07	13.68	86.32
Nov. 26, 1890, 6.00 P.M., . .	3.95	9.67	13.62	86.38
Feb. 26, 1891, 5.00 P.M., . .	4.46	9.79	14.25	85.75
AVERAGE, ...	4.03	9.84	13.87	86.13

No. 16. Mixed; six years old.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
May 28, 1890, 6.00 P.M., . .	2.65	10.46	13.11	86.89
Aug. 27, 1890, 6.00 P.M., . .	2.81	10.08	12.89	87.11
Nov. 26, 1890, 6.00 P.M., . .	3.79	10.37	14.16	85.84
AVERAGE, ...	3.08	10.30	13.38	86.62

No. 17. Mixed.

Aug. 27, 1890, 6.00 P.M., . .	3.40	9.70	13.10	86.90
Nov. 26, 1890, 6.00 P.M., . .	2.66	9.85	12.51	87.49
Feb. 26, 1891, 5.00 P.M., . .	3.65	9.97	13.62	86.38
AVERAGE, ...	3.24	9.84	13.08	86.92

No. 18. Mixed.

Aug. 27, 1890, 6.00 P.M., . .	4.50	9.95	14.45	85.55
Nov. 26, 1890, 6.00 P.M., . .	2.28	10.37	12.65	87.35
Feb. 25, 1891, 5.00 P.M., . .	3.20	10.05	13.25	86.75
AVERAGE, ...	3.33	10.12	13.45	86.55

No. 19. Mixed.

Aug. 27, 1890, 6.00 P.M., . .	2.75	9.38	12.13	87.87
Nov. 26, 1890, 6.00 P.M., . .	3.56	10.08	13.64	86.36
Feb. 25, 1891, 5.00 P.M., . .	3.02	9.76	12.78	87.22
AVERAGE, ...	3.11	9.74	12.85	87.15

No. 20.

Aug. 27, 1890, 6.00 P.M., . .	3.01	8.76	11.77	88.23

No. 21.

Aug. 27, 1890, 6.00 P.M., . .	2.90	9.78	12.68	87.32

No. 22. Mixed.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Nov. 26, 1890, 6.00 P.M., . .	2.95	10.14	13.09	86.91
Feb. 25, 1891, 5.00 P.M., . .	3.42	9.59	13.01	86.99
AVERAGE, ...	3.18	9.87	13.05	86.95

No. 23. Mixed.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Nov. 26, 1890, 6.00 P.M., . .	2.90	10.42	13.32	86.68
Feb. 25, 1891, 5.00 P.M., . .	3.80	10.00	13.80	86.20
AVERAGE, ...	3.35	10.21	13.56	86.44

No. 24. Mixed.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Nov. 26, 1890, 6.00 P.M , . .	3.25	10.01	13.26	86.74
Feb. 25, 1891, 5.00 P.M., . .	3.29	9.78	13.07	86.93
AVERAGE, ...	3.27	9.89	13.16	86.84

No. 25. Mixed.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Nov. 26, 1890, 6.00 P.M , . .	3.20	10.42	13.62	86.38

No. 26.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Feb. 25, 1891, 5.00 P M., . .	3.46	9.83	13.29	86.71

No. 27.

DATE OF TAKING SAMPLE.	Fat.	Solids not Fat.	Total Solids.	Water.
Feb. 25, 1891, 5.00 P.M., . .	2.57	9.97	12.54	87.46

A part of the dairy farms represented in the following analyses were selected in consequence of the predominance of Holstein cows among them.

Time of Year.	Where obtained.	Age of Cow.	Breed.	Character of Feed.	Fat.	Solids not Fat.	Total Solids.	Water.
1890.								
April 14, 1 P.M.,	Brockton,	6 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	3.67	9.20	12.87	87.13
" "	"	6 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	3.65	9.22	12.87	87.13
" "	"	7 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	3.33	9.15	12.48	87.52
" "	"	6 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	3.36	8.81	12.17	87.83
" "	"	4 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	4.30	9.87	14.17	85.83
" "	"	5 years,	Holstein,	One quart gluten meal, five quarts shorts, four quarts corn meal, ensilage and hay,	3.26	8.51	11.77	88.23
" "	"	11 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	3.96	9.23	13.19	86.81
" "	"	4 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	4.03	9.67	13.70	86.30
" "	"	4 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	3.73	9.27	13.00	87.00
" "	"	6 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	5.12	9.41	14.53	85.47
" "	"	2 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	4.26	9.13	13.41	86.59
" "	"	8 years,	Holstein,	One quart gluten meal, two quarts shorts, four quarts corn meal, ensilage and hay,	3.31	8.85	12.16	87.84
AVERAGE,					3.83	9.19	13.02	86.98

TIME OF YEAR.	Where obtained.	Age of Cow.	Breed.	Character of Feed.	Fat.	Solids not Fat.	Total Solids.	Water.
1890. July 10, 6 P.M.,	Andover,	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.71	8.62	11.33	88.67
" "	"	8 years,	Holstein and Ayrshire,	Three quarts corn meal, shorts and pasture,	2.16	7.89	10.05	89.95
" "	"	12 years,	Mixed,	Three quarts corn meal, shorts and pasture,	2.55	9.70	12.25	87.75
" "	"	8 years,	Mixed,	Three quarts corn meal, shorts and pasture,	2.02	8.50	10.52	89.48
" "	"	5 years,	Holstein,	Three quarts corn meal, shorts and pasture,	3.04	9.47	12.51	87.49
" "	"	8 years,	Mixed,	Three quarts corn meal, shorts and pasture,	3.20	8.42	11.62	88.38
" "	"	12 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.00	9.40	11.40	88.60
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	1.80	8.47	10.27	89.73
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.04	8.01	10.05	89.95
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	3.38	9.19	12.57	87.43
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.70	9.11	11.81	88.19
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.40	10.63	13.03	86.97
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	3.36	9.39	12.75	87.25
" "	"	8 years,	Holstein and Durham,	Three quarts corn meal, shorts and pasture,	2.49	8.74	11.23	88.77
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.53	9.33	11.86	88.14
" "	"	8 years,	Holstein,	Three quarts corn meal, shorts and pasture,	2.66	9.25	11.91	88.09
AVERAGE,					2.56	9.01	11.57	88.43
1890. Aug. 26, 4.30 P.M.,	Berkley,	8 years,	Ayrshire,	One quart cotton seed, one quart meal, two quarts shorts,	3.16	8.56	11.72	88.28
" "	"	2½ years,	Holstein,	One quart cotton seed, one quart meal, two quarts shorts,	3.56	8.88	12.44	87.56

" "	"	4 years,	Ayrshire,	One quart cotton seed, one quart meal, two quarts shorts,	3.32	8.64	11.96	88.04
" "	"	7 years,	Native,	One quart cotton seed, one quart meal, two quarts shorts,	3.54	8.22	11.76	88.24
" "	"	8 years,	Ayrshire,	One quart cotton seed, one quart meal, two quarts shorts,	1.56	9.38	10.94	89.06
" "	"	7 years,	Native,	One quart cotton seed, one quart meal, two quarts shorts,	3.66	8.96	12.62	87.38
" "	"	8 years,	Ayrshire,	One quart cotton seed, one quart meal, two quarts shorts,	3.50	8.50	12.00	88.00
" "	"	6 years,	Grade Ayrshire,	One quart cotton seed, one quart meal, two quarts shorts,	3.56	9.58	13.14	86.86
" "	"	4 years,	Holstein,	One quart cotton seed, one quart meal, two quarts shorts,	3.76	8.70	12.46	87.54
" "	"	4 years,	Holstein,	One quart cotton seed, one quart meal, two quarts shorts,	3.48	8.40	11.88	88.12
" "	"	9 years,	Holstein,	One quart cotton seed, one quart meal, two quarts shorts,	3.06	8.22	11.28	88.72
" "	"	4 years,	Native,	One quart cotton seed, one quart meal, two quarts shorts,	4.46	9.44	13.90	86.10
AVERAGE,					3.38	8.79	12.17	87.83
1890. Sept. 12, 5 P.M.,	Town Farm, Salem,	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	2.92	9.27	12.19	87.81
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	3.40	8.99	12.39	87.61
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	2.89	8.80	11.69	88.31
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	2.51	9.30	11.81	88.19
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	3.59	9.60	13.19	86.81
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	3.11	10.59	13.70	86.30
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	3.45	9.60	13.05	86.95
" "	" "	Between 8 and 11 years,	Holstein,	One quart corn, two quarts oats, one quart middlings, hay and grass,	3.09	9.13	12.22	87.78
AVERAGE,					3.12	9.41	12.53	87.47

TIME OF YEAR.	Where obtained.	Age of Cow.	Breed.	Character of Feed.	Fat.	Solids not Fat.	Total Solids.	Water.
1890.								
Sept. 19, 5 P.M.,	Town Farm, Wakefield,	8 years,	Durham and Ayrshire,	One quart corn meal, one quart middlings, two quarts shorts twice a day, pasture and hay,	3.51	9.28	12.79	87.21
" "	" "	8 years,	Durham and Ayrshire,	One quart corn meal, one quart middlings, two quarts shorts twice a day, pasture and hay,	3.31	9.62	12.93	87.07
" "	" "	5 years,	Durham and Ayrshire,	One quart corn meal, one quart middlings, two quarts shorts twice a day, pasture and hay,	2.24	9.86	12.10	87.90
" "	" "	6 years,	Durham and Ayrshire,	One quart corn meal, one quart middlings, two quarts shorts twice a day, pasture and hay,	2.40	9.23	11.63	88.37
" "	" "	9 years,	Durham and Ayrshire,	One quart corn meal, one quart middlings, two quarts shorts twice a day, pasture and hay,	2.49	8.81	11.30	88.70
AVERAGE,					2.79	9.36	12.15	87.85
1890.								
Oct. 8, 4 P.M.,	Berkley,	5 years,	Native,	Four quarts meal,	4.68	10.30	14.98	85.02
" "	"	5 years,	3 Holstein, 1 Native,	Four quarts meal,	Mixed 2.78	milk. 9.70	12.48	87.52
" "	"	6 years,	Native,	Four quarts meal,	2.96	9.04	12.00	88.00
" "	"	9 years,	Ayrshire,	Four quarts meal,	2.58	9.52	12.10	87.90
" "	"	6 years,	Grade Ayrshire,	Four quarts meal,	3.20	10.04	13.24	86.76
" "	"	5 years,	Jersey,	Four quarts meal,	3.68	9.94	13.62	86.38
" "	"	8 years,	Ayrshire,	Four quarts meal,	1.92	10.18	12.10	87.90
" "	"	4 years,	Ayrshire,	Four quarts meal,	2.94	9.34	12.28	87.72
" "	"	3 years,	Holstein,	Four quarts meal,	2.74	10.18	12.92	87.08
" "	"	2 years,	Grade Devon,	Four quarts meal,	4.92	9.84	14.76	85.24
" "	"	5 years,	Native,	Four quarts meal,	5.04	10.50	15.54	84.46
" "	"	2 years,	Grade Devon,	Four quarts meal,	4.58	9.52	14.10	85.90
AVERAGE,					3.50	9.84	13.34	86.66

1891. Feb. 7, 5 P.M.,	Concord,	5 years,	Grade,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	3.57	9.52	13.09	86.91
" "	"	3 years,	Grade Jersey,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	5.10	10.09	15.19	84.81
" "	"	3 years,	Grade Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.12	9.63	13.75	86.25
" "	"	3 years,	Grade Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	3.55	9.44	12.99	87.01
" "	"	3 years,	Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.88	9.79	14.67	85.33
" "	"	11 years,	Grade Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.27	9.68	13.95	86.05
" "	"	12 years,	Mixed,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.27	9.97	14.24	85.76
" "	"	5 years,	Mixed,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	3.98	9.70	13.68	86.32
" "	"	5 years,	Grade Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	3.81	9.29	13.10	86.90
" "	"	6 years,	Devon,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	3.88	9.05	12.93	87.07
" "	"	6 years,	Grade Holstein,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.26	9.35	13.61	86.39
" "	"	8 years,	Mixed,	Three and one-half pounds gluten, three and one-half pounds linseed meal, fifty pounds ensilage and five pounds hay each per day,	4.01	9.87	13.88	86.12
AVERAGE,					4.14	9.61	13.75	86.25

Drugs.

The statute of 1882, relative to food and drug inspection, carefully defines the meaning of important terms which are employed in the act. The term "drug" is defined as including "all medicines for internal or external use, antiseptics, disinfectants and cosmetics," and in a further classification, embodied in section 3 of chapter 263 of the Acts of 1882, and amended by section 7 of chapter 289 of the Acts of 1884, adulteration of drugs is specified as applying (1) to such articles as are named in the United States Pharmacopœia; (2) to articles named in other Pharmacopœias or standard works on Materia Medica; and (3) to any articles sold under a "professed standard."

Under the broad provisions of these acts the Board has during the past seven years examined a great variety of the articles and preparations which are included in these definitions of the term "drug." Its work in this direction has, however, been devoted mainly to the important list of articles specified in the United States Pharmacopœia. After a year or more of investigation and preliminary work for the purpose of ascertaining what articles were specially liable to adulteration, these articles were afterward usually selected by the inspectors in their collection of samples.

Within the past year there was a sudden increase in the number of empirical preparations used as cosmetics, and especially of certain articles advertised for the purpose of "improving or beautifying" the complexion. Upon examination of these preparations several of them were found to be of an unusually poisonous character. They contained from three to eight grains of bichloride of mercury (corrosive sublimate) to the fluid ounce, the principal ingredients being corrosive sublimate, water and a little tincture of benzoin. In the case of one of these articles, Madame Ruppert's Face Bleach, it was further stated that "*it is guaranteed harmless, containing no arsenic, lead, bismuth, sulphur, lime or anything injurious to the skin. Its effect is always beneficial.*"

Another preparation, Madame Fale's Excelsior Complexion Bleach, put up in the same attractive form, is stated to be "*composed of strictly harmless ingredients*," but was found on analysis to be nearly identical with the former, and containing the same violent poison. These articles were heralded by glowing advertisements, and in the case of the latter a public hall in Boston was secured, a band of music, and a free lecture given for the purpose of introducing the preparation to the public. To the credit of the people it should be stated that the audience was very small.

Instances of serious harm from the use of these articles came to the knowledge of the Board, a fact which is not surprising when it is known that deaths have occurred in several instances from the external use of strong solutions of corrosive sublimate. (See Orfila, Toxicology, vol. 1, p. 59; also London Medical Gazette, vol. 3, p. 666; Western Journal Medical and Physical Science, vol. 4, p. 483; Gazette des Hôpitaux.) If such preparations are used at all, they should only be sanctioned if accompanied by careful instructions, and with knowledge of their poisonous character on the part of the user. The statement as to composition is not only false, in calling them harmless, but also misleading in the statement that they contain no arsenic, lead, bismuth, sulphur, etc. Corrosive sublimate is far more poisonous than either of them, with perhaps the single exception of arsenic.

The liberal use of such articles externally must not only lead to serious results, but the misleading statement as to their composition would also necessarily lead to a want of proper care in their use, such, for example, as their accidental internal use by children or others.

It was for the purpose of preventing such accidents, and such serious results as might occur in the use of poisonous articles, that the following statute was enacted in 1888: —

[Chapter 209, Acts of 1888.]

An Act regulating the sale and purchase of poison.

Whoever sells arsenic (arsenious acid), atropia or any of its salts, chloral hydrate, chloroform, cotton root and its fluid extract, corrosive sublimate, cyanide of potassium, Donovan's solution, ergot and its fluid extract, Fowler's solution, laudanum, McMunn's elixir, morphia or any of its salts, oil of pennyroyal, oil of savin, oil of tansy, opium, Paris green, Parsons' vermin exterminator, phosphorus, prussic acid, "rough on rats," strychnia or any of its salts, tartar emetic, tincture of aconite, tincture of belladonna, tincture of digitalis, tincture of nux vomica, tincture of veratrum viride, without the written prescription of a physician, shall keep a record of such sale, the name and amount of the article sold, and the name and residence of the person or persons to whom it was delivered, which record shall be made before the article is delivered, and shall at all times be open to inspection by the officers of the district police and by the police authorities and officers of cities and towns. Whoever neglects to keep or refuses to show to said officers such record shall be punished by fine not exceeding fifty dollars. Whoever sells any of the poisonous articles named in this section, without the written prescription of a physician, shall affix to the bottle, box or wrapper containing the article sold a label of red paper upon which shall be printed in large black letters the word — Poison, and also the word — Antidote, and the name and place of business of the vendor. The name of an antidote, if there be any, for the poison sold shall also be upon the label. Every neglect to affix such label to such poisonous article before the delivery thereof to the purchaser shall be punished by fine not exceeding fifty dollars. Whoever purchases poison as aforesaid and gives a false or fictitious name to the vendor shall be punished by fine not exceeding fifty dollars: *provided*, that nothing in this act shall be construed to apply to wholesale dealers and to manufacturing chemists in their sales to the retail trade.

The preparations already named were sold in violation of most of the provisions of this act. No "written prescription of a physician" was called for; no "record of the sale" was made, and "the name and residence of the person to whom it was delivered" was not reported in either instance. The word "poison" was not placed upon the bottle, and the "name of the antidote" was also omitted.

In view of these facts, complaints were made out against the agents who sold these two preparations in Boston, and at the trial, which took place in December, both were convicted and fined under the aforesaid statute.

Two other preparations, bearing the names of Soule's Eradicator and Delisle's Royal Cream, were examined soon afterward and found to contain corrosive sublimate in about the same proportion or strength. Parties selling these articles were also convicted and fined under the same act.

The earlier operations of the Board, having reference to requiring a conformity to the recognized standard of the United States Pharmacopœia, so far as officinal preparations are concerned, had a very marked effect in securing a general improvement in the quality of officinal drugs. This effect was by no means of a temporary character, but has continued to improve up to the present time, and many articles which were once of an uncertain character, so far as their conformity to any fixed standard was concerned, are now quite uniform as offered for sale. The advantage of this improvement, both to the medical practitioner and to the public, is very great.

PROSECUTIONS.

By the provisions of chapter 289 of the Acts of 1884 the Board is required to report the number of prosecutions conducted under the food and drug acts, together with an account of the expenditures incurred.

In compliance with this provision the following account was transmitted to the Legislature: —

OFFICE OF THE STATE BOARD OF HEALTH,
13 BEACON STREET, BOSTON, March, 1891.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The following summary is made in compliance with the provisions of chapter 289, section 2, of the Acts of 1884, requiring the State Board of Health to "report annually to the Legislature the number of prosecutions made under chapter 263 of the Acts of 1882, and an itemized account of all money expended in carrying out the provisions thereof."

The whole number of prosecutions made by authority of the Board against offenders, under the provisions of the food and drug acts, for the year ending Sept. 30, 1890, was 102.

The cities and towns in which the articles were sold, and in respect to which complaints were entered in court, the character of the articles found to be adulterated, or fraudulently sold, the dates of the trials and their result, are presented in the following table: —

MILK AND MILK PRODUCTS.

For Fraudulent Sales of Milk.

PLACE.	DATE.	RESULT.
In Boston,	Nov. 6, 1889,	Convicted.
Boston,	Nov. 20, 1889,	Convicted.
Boston,	June 25, 1890,	Discharged in Superior Court.
Boston,	June 25, 1890,	Convicted.
Lowell,	Nov. 2, 1889,	Convicted.
Cambridge,	Mar. 15, 1890,	Discharged.
Groton,	Nov. 12, 1889,	Convicted.
Southborough,	Nov. 22, 1889,	"
Southborough,	Dec. 20, 1889,	"
Southborough,	Aug. 29, 1890,	"
Lincoln,	Oct. 5, 1889,	"
Lincoln,	Mar. 18, 1890,	Nol Pros.
Needham,	Dec. 21, 1889,	Convicted.
Sudbury,	Dec. 6, 1889,	"
Lexington,	Dec. 13, 1889,	"
Harvard,	Dec. 24, 1889,	"
Berlin,	Jan. 4, 1890,	"
Sterling,	Jan. 24, 1890,	"
Medfield,	Mar. 14, 1890,	"
Revere,	Mar. 29, 1890,	Discharged.
Revere,	Mar. 29, 1890,	Convicted.
Marlborough,	May 9, 1890,	"
Andover,	June 30, 1890,	"
Ashland,	Sept. 6, 1890,	"

Total, 24 cases.

For Fraudulent Sales of Adulterated Butter (Oleomargarine).

In Salem,	Oct. 29, 1889,	Convicted.
Salem,	Nov. 16, 1889,	Discharged.
Somerville,	Nov. 4, 1889,	Convicted.
Lowell,	Nov. 18, 1889,	"
Lowell,	Nov. 18, 1889,	"
Lowell,	July 16, 1890,	"
Lowell,	July 21, 1890,	"
Lowell,	Aug. 27, 1890,	"
Fall River,	Nov. 19, 1889,	"
Fall River,	Nov. 26, 1889,	"
Fall River,	Nov. 26, 1889,	"
Fall River,	Jan. 29, 1890,	"
Fall River,	Mar. 19, 1890,	"
Worcester,	Dec. 4, 1889,	Discharged.
Worcester,	Mar. 31, 1890,	Discharged in Superior Court.
Holyoke,	April 24, 1890,	Convicted.
Holyoke,	April 24, 1890,	"
Lynn,	Mar. 27, 1890,	"

For Fraudulent Sales of Adulterated Butter (*Oleomargarine*) — Concluded.

Place.	Date.	Result.
In Cambridge,	Sept. 25, 1890,	Convicted.
Cambridge,	Sept. 25, 1890,	“
Cambridge,	Sept. 29, 1890,	“
Brockton,	Dec. 23, 1889,	“
Lawrence,	June 10, 1890,	“
New Bedford,	April 24, 1890,	“
Springfield,	Jan. 24, 1890,	“
Waltham,	May 21, 1890,	“
Marlborough,	Mar. 20, 1890,	“
Amesbury,	Dec. 12, 1889,	“
Warren,	Jan. 25, 1890,	“
Uxbridge,	Feb. 13, 1890,	“
Uxbridge,	Feb. 25, 1890,	“
Blackstone,	Feb. 24, 1890,	“
Millville,	Feb. 24, 1890,	“
Millville,	Feb. 26, 1890,	“
Millville,	Feb. 26, 1890,	“
Franklin,	Mar. 15, 1890,	“
Abington,	June 9, 1890,	“

Total, 37 cases.

OTHER ARTICLES OF FOOD.

Molasses.

In Boston,	Dec. 14, 1889,	Convicted.
Boston,	Feb. 26, 1890,	“
Boston,	May 29, 1890,	“
Boston,	June 7, 1890,	“
Boston,	June 7, 1890,	“
Boston,	June 5, 1890,	“
Boston,	June 6, 1890,	“
Boston,	June 13, 1890,	“
Boston,	Sept. 29, 1890,	“
Holyoke,	April 29, 1890,	“
Holyoke,	April 29, 1890,	“
Lee,	May 23, 1890,	“
Fall River,	June 26, 1890,	“
Fall River,	June 30, 1890,	“
Fall River,	July 15, 1890,	“
Fitchburg,	Sept. 27, 1890,	“
Fitchburg,	Sept. 30, 1890,	“
Springfield,	June 4, 1890,	“
Pittsfield,	June 20, 1890,	“
Cambridge,	June 28, 1890,	“
Haverhill,	June 5, 1890,	“
Ware,	June 5, 1890,	“
Palmer,	July 19, 1890,	“

Maple Syrup.

Place.	Date.	Result.
In Somerville,	Oct. 28, 1889,	Convicted
Fall River,	July 22, 1890,	"
Lowell,	April 25, 1890,	"
Lowell,	April 25, 1890,	"
Springfield,	May 6, 1890,	"
Adams,	May 28, 1890,	"
Great Barrington,	April 22, 1890,	"

Honey.

In Waltham,	Dec. 28, 1889,	Convicted.

Pepper.

In Boston,	Jan. 17, 1890,	Convicted.
Boston,	Jan. 17, 1890,	"
Brockton,	Mar. 28, 1890,	"

Mustard.

In Adams,	May 28, 1890,	Convicted.
Boston,	June 11, 1890,	Convicted.

Cream of Tartar.

In North Adams,	April 23, 1890,	Convicted.
Hopkinton,	Aug. 19, 1890,	"
Fitchburg,	Sept. 11, 1890,	"

Allspice.

In North Adams,	April 23, 1890,	Convicted.

Vinegar.

In Hopkinton,	Aug. 20, 1890,	Convicted.

Milk,	24 cases.
Butter,	37 "
Other articles of food	41 "
Total,	102 "

SUMMARY.

The whole number of complaints entered by the State Board of Health against parties for violation of the acts relative to the adulteration of food and drugs was 102, of which number 96, or 94.1 per cent., resulted in conviction.

Six parties were discharged either in the municipal or the superior courts. Of these cases 24 were for violation of the laws relative to the adulteration of milk, 21 of which resulted in conviction, and in 3 cases the parties were discharged.

There were 37 complaints under the oleomargarine laws; in 34 the parties were convicted, and in 3 they were discharged.

There were also 41 complaints for fraudulent sales of other articles of food, in all of which the parties were convicted. The adulterated articles of food for which these complaints were entered were the following: Molasses, 23 cases; maple syrup, 7 cases; honey, 1 case; pepper, 3 cases; mustard, 2 cases; cream of tartar, 3 cases; allspice, 1 case; vinegar, 1 case.

In three of the cases which were discharged, the acquittal was due to the inability of the complainant to fix the responsibility of the offence upon the proper person.

In two cases, the parties against whom complaint was made had disappeared before the trial and could not be found.

In three cases, all of which were offences against the oleomargarine laws, the convictions secured in the municipal courts were reversed by the superior courts.

In a large proportion of the cases appeals were taken, but in nearly all of these the defendants paid their fines before the cases were again called for trial.

Fines.

The amount of the fines paid to the treasuries of counties, cities and towns, under the provisions of the general and special laws relative to the inspection of food and drugs, was as follows: —

Fines paid for Violation of the Food and Drug Acts, upon Cases entered for the Year ending Sept. 30, 1890.

Under the provisions of the milk laws,	$825 00
Under the provisions of the oleomargarine or butter laws,	2,356 00
Under the provisions of laws relative to other articles of food,	738 00
Total,	$3,919 00

EXPENDITURES.

Expenses of Food and Drug Inspection from Oct. 1, 1889, to Sept. 30, 1890, under the Provisions of Chapter 263 of the Acts of 1882 and Chapter 289 of the Acts of 1884 relative to Food and Drug Inspection.

	Milk and Milk Products.	Other Articles of Food and Drugs.
Salaries of analysts,	$3,000 00	$1,700 00
Salaries of inspectors,	1,720 00	1,146 66
Travelling expenses and purchase of samples,	1,348 73	901 27
Legal services,	82 80	55 20
Incidentals, boxes, bags, bottles, corks, twine, etc., for sample collection,	41 34	–
Printing,	17 04	–
	$6,209 91	$3,803 13
		6,209 91
Total,		$10,013 04

REPORTS OF THE ANALYSTS.

REPORTS OF THE ANALYSTS.

DR. HARRINGTON'S REPORT UPON FOOD.

Boston, Mass., Oct. 1, 1890.

Dr. S. W. Abbott, *Secretary of the State Board of Health.*

Dear Sir: — I have the honor to submit the following report on the analysis of foods for the year ending September 30.

The number of samples received and examined was 1,849; of this number there were but 313 which were not of standard purity. The only unusual adulterants detected were borax, which was found in considerable amounts in two samples of powdered sugar, and salicylic acid, which was present in three fruit syrups and two samples of beer. The other adulterants detected were of the same general character as described in previous reports.

The following samples were received: —

Molasses, 431. Seventy samples were adulterated with corn glucose in varying amounts. The remainder were genuine.

Vinegar, 183. One hundred and thirty-one were above standard, and fifty-two were deficient in acidity or residue or in both. A few of the adulterated samples were white wine vinegar colored with caramel.

Cream of tartar, 194. Twenty-five samples contained one or more of the common adulterants, — corn starch, rice flour, alum, calcium sulphate, acid phosphate, etc.

Butter, 42. One proved to be oleomargarine, which was sold in an unmarked wrapper.

Cheese, 14. All genuine.

Maple syrup, 21, and *Maple sugar*, 18. Thirteen of the former and four of the latter were found to be adulterated with glucose or brown sugar.

Honey, 27. Eleven were adulterated with glucose. Six of these bore labels, as follows: —

Nos. 2,157 and 7,181. "Pure White Clover Honey for Medicinal Use. D. Geer."
No. 7,603. "White Clover Honey. J. R. Ladd."
Nos. 7,002 and 8,232. "David Holland, Peacham, Vt."
No. 3,769. "Murray Geer, Aroostook County, Maine."

Sugar, 22. Two contained borax. Additional samples from the same source were found to be pure.

Confectionery, 22. These were examined with special reference to poisonous colors, which were in no case detected.

Tea, 55. One sample contained an undue amount of dirt.

Coffee, 21. Three consisted wholly of roasted cereals.

Cocoa, 8. Four contained wheat flour.

Olive oil, 22. Ten proved to be an inferior substitute, or olive oil containing a small proportion of cotton-seed oil.

Baking powders, 11. All of these contained alum. The following brands were represented: —

Anchor.
Balloon.
New England.
Universal.
Violet.

Soda, 13. All genuine.

Lard, 21. Six samples were adulterated with cottonseed oil and stearine.

Black pepper, 151. Thirty-five were adulterated. The following brands were represented among the latter: —

Bowen's.
Bacon, Stickney & Co.
Globe Mills.
E. W. Ropes.
Tropical Mills.
Springfield Mills.

White pepper, 26. Six samples, including one each marked Knickerbocker Mills and E. S. Kibbe, Hartford, Conn., were adulterated.

Cloves, 135. Eighteen were adulterated, including samples marked —

Wing & Large, Troy, N. Y.
India Mills, New York.
E. W. Ropes, New York.
P. H. Sands, Connecticut.

Cayenne, 19. Three were adulterated. One of these was marked E. R. Durkee & Co., New York.

Mace, 12. Two marked E. W. Ropes, New York, were adulterated.

Ginger, 72. Seven samples, two of which were from India Mills, New York, were adulterated.

Mustard, 62. Twenty-three adulterated. Among the latter were the following brands: —

Moshier Bros., New York.
Ardenter.
Freeman's.
Bowen's.

Cassia, 144. Eight adulterated. The only brand among the latter was E. W. Ropes, New York.

Allspice, 64. Two samples, both unmarked, were adulterated.

Canned foods, 17. These included one sample each of asparagus and pease and fifteen of condensed milk. One sample of the latter contained slight metallic contamination; all the others were of good quality.

Miscellaneous. The following were found to be of good quality : —

Sage, nutmeg, gelatine, 2 each ; savory, curry, apple jelly, vermicelli, chocolate, horseradish, lemon syrup, chicory, "egg custard," lager beer, 1 each.

The following were adulterated : —

Strawberry syrup, 1 ; apricot juice, 2 ; alica beer, 1 ; and Kaiser beer, 1, with salicylic acid ; and lemon juice, 1, which proved to be a weak solution of citric acid in water.

Total, 1,849 ; 1,536 genuine, 313 adulterated.

Respectfully,

CHARLES HARRINGTON, M.D.

DR. DAVENPORT'S REPORT UPON FOOD.

Boston, Oct. 1, 1890.

Dr. S. W. Abbott, *Secretary State Board of Health.*

Sir: — I have the following report to make upon the 500 samples of food submitted to me for examination during the past twelve months. Of these, 377, or 75.4 per cent., proved to be of the good standard quality called for under the food laws of this State.

Among them were 128 samples of butter, of which 58 proved not to be butter as was called for, but oleomargarine in its stead. In this connection the following extract from the report of the United States Consul at Munich, Germany, to the Department of State at Washington is of interest: —

> In connection with the many propositions which have been made about coloring of oleomargarine so that it will be impossible to substitute oleomargarine for natural butter, a suggestion made by Dr. F. Soxhlet, professor in the Technological Institute and chief of the Agricultural Experiment Station at Munich, is particularly interesting. Starting with the idea that any strong coloring matter would cause a deterioration in oleomargarine both in delicacy and in nourishing qualities, Professor Soxhlet proposes to add a harmless substance, in small quantity, which would in no way change the color, taste, smell or usefulness of oleomargarine, but which, while it cannot be removed from the oleomargarine will yet furnish every one with an easily applied test; so that if only one-tenth part of a mixture is oleomargarine it can be at once discovered. The professor recommends as such a substance, phenol-phthaline, to be added to the oleomargarine in the proportion of one part to one hundred thousand, — that is, of one ounce to three short tons of the oleomargarine.
>
> A piece as large as a pea of oleomargarine which had been thus treated, if placed upon a white surface and a drop of a strong solution of any one of the common domestic alkalies, such as soda, potash or ammonia, rubbed into it would immediately develop a

strong pink color. A little cigar ashes even rubbed into the oleomargarine placed upon a piece of white paper would stain the paper pink. Any market inspector could then make hundreds of such examinations in a very short time, and every consumer would be furnished with an easy and certain test. This manner of preparing the oleomargarine with phenol-phthaline would not injuriously affect the artificial butter at any stage of its manufacture or at any time in its use. The color would never be developed uncalled for, as in preparing food it would not come in contact with any strong alkali and so would not become discolored.

Of the 4 cheese samples examined none contained any forbidden admixture. But of 3 lards 1 contained a large admixture of cotton-seed oil, and out of 6 samples of olive oil 2 were mostly, if not wholly, of the same cotton-seed oil.

Of 25 samples of cider vinegar 12 were either colored white wine, that is, spirit vinegar, alone or mixed with some little cider for flavor, or else they were of cider vinegar stock but partially converted or else somewhat watered.

Among the common spices there were 46 peppers, of which 8 contained large admixtures of foreign vegetable substances, such as starches, flours, buckwheat middlings and the like, or in some cases they were wholly grains of paradise, which have been known in commerce as Mallaguetta pepper.

Of 14 samples of mustard 1 contained over 25 per cent. of powdered talc. Of 20 cinnamon, 9 allspice, 10 cloves and 8 other spices all but one of each variety were of proper quality, while 1 mace, 2 ginger and 1 capsicum were all good.

Of 73 samples of cream of tartar all but 7 were as they should be. These contained, in some cases, the well-known admixture of starch, gypsum and the like, or had a substitution of the acid phosphate of lime. Some, however, contained no cream of tartar at all, but were simply straight powdered gypsum, to which only sufficient acid phosphate or tartaric acid had been added to give the mixture about the usual degree of tart taste possessed by cream of tartar. The makers of these powders had taken advantage of the not generally well-known fact that straight gypsum will act quite efficiently upon bicarbonate of soda in liberating its gas when aided by a degree of heat much below that of a baking oven. Much of such a powder is, of course, left in the bread in the inert form of chalk. The single sample of baking powder examined was found to be of the straight cream of tartar and soda bicarbonate variety.

Out of 87 samples of molasses 15 were found to contain a large admixture of foreign glucose syrup, that is, ranging from 50 to 90 per cent. of glucose. This is not quite as bad a showing as I experienced with 20 samples which were collected in an adjoining State which has not as yet a general food-adulteration law. Out of these 20 samples I found 18 which were even more admixed than the worst of our own, several of them being nothing short of total substitution; one of them even being a glucose syrup very imperfectly converted from its dextrine condition.

Out of 13 samples of maple syrup 3 contained large admixture of foreign glucose syrup, while of 12 maple sugars 5 consisted mostly of molasses or brown sugar. Of honey 2 samples, and of confectionery 5 were all of standard quality.

Out of 18 samples of tea and 5 of coffee all were of good quality. In coffee several new admixtures have proved of interest. One, consisting of an entirely artificial coffee substitute, has been placed upon the market pressed into the form of whole coffee beans. It is composed of a brown-bread mixture, and is made up to a very close imitation of the color of roasted coffee. Mixed with the whole coffee, which customers have ground for themselves at the time of purchase, the chances of its presence being observed as the beans are being turned into the chopper of the mill are very slight indeed. All such starch substitutes are, however, readily detected when mixed with coffee by placing a small quantity of it upon the surface of some water in a glass and noting whether streams of caramel color are quickly seen descending from the floating mass, and whether particles soon sink to the bottom, which, upon further examination, are found to be soft, easily crushed, and present starch granules, which, when viewed through a microscope, will take on the familiar blue coloration upon the addition of an iodine solution. A coffee substitute of practically the same materials as the moulded beans is also sold in the bulk form under the trade name of "P. P. C.," which is translated as the "patent process compound." This is made up in two forms — "with" and "without;" that is, with or without the addition of chicory. A quite ingenious form of substitute is that made from pease which have been steamed, then pressed flat and roasted. The starch granules are thereby so altered in form as not to be readily recognized from their appearance, and the starch substance is so far converted as not to readily take on the familiar blue reaction with iodine solution. It will, however, develop after the lapse of several hours. The peculiar palisade formation of the cells in the cuticle of the pea, however, not being altered, will readily, to the practised eye, identify the admixture as belonging to the pulse family.

Out of the 3 samples of condensed milk examined 2 were found to be of the usual skim-milk quality.

Of the 2 samples of preserved lemon juice neither was found to be nearly of full strength, while of 2 samples of vanilla extract 1 was found to be mostly tonka bean.

BENNETT F. DAVENPORT,
Analyst.

DR. DAVENPORT'S REPORT.

MILK.

Boston, Oct. 1, 1890.

Dr. S. W. Abbott, *Secretary State Board of Health.*

Sir: — I have the following report to make upon the 843 samples of milk which were submitted to me for examination during the past twelve months. Out of these, although the collections were made largely from the more strongly suspected sources, only 321, or 38.08 per cent., were found to fall below the legal requirements for "good standard quality."

The detailed results of my analysis were as follows: —

Number above the standard,	522	
Number below the standard,	321	
Total,	——	843
Number having more than 15 per cent. of total solids,	36	
" " between 14 and 15 per cent. of total solids,	79	
" " " 13 and 14 " " "	322	
" " " 12 and 13 " " "	322	
" " " 11 and 12 " " "	66	
" " " 10 and 11 " " "	12	
" " " 9 and 10 " " "	4	
" " " 8 and 9 " " "	1	
Number having less than 8 per cent. of total solids,	1	
Number samples of skimmed milk above the standard,	11	
Number samples of skimmed milk below the standard,	1	
Number samples of colored milk,	0	

BENNETT F. DAVENPORT,
Analyst.

DR. WORCESTER'S REPORT.

MILK.

BOSTON, Jan. 1, 1891.

Dr. S. W. ABBOTT, *Secretary of the State Board of Health.*

DEAR SIR:—I have the honor to submit the following report on the examination of milk for the year ending Sept. 30, 1890:—

During the year I received 2,123 samples. Of this number 1,224 were collected from the supply of 19 cities of the State, 277 were from 16 towns, 30 were taken from the town farms of 4 cities or towns, 261 were from suspected producers and 331 were samples of known purity.

I have included in this number samples of known purity taken by the inspectors in October, November and December, 1890, in order to complete the series of known purity samples which were taken from a herd once every month during the calendar year 1890.

Of the whole number, 996, or 46.9 per cent., were of less than standard quality, and 376, or 17.7 per cent., contained less than 12 per cent. of total solids.

Inspection of Nineteen Cities' Supply.

	Number of Samples taken.	Number of Samples below Standard.	Number of Samples containing Less than 12 Per Cent. of Solids.
Boston,	82	48	13
Brockton,	12	4	1
Cambridge,	226	135	46
Chelsea,	71	28	6
Fall River,	14	1	1
Gloucester,	25	20	13
Haverhill,	84	40	14
Lawrence,	121	46	12
Lowell,	129	51	12
Lynn,	73	43	23
Malden,	24	20	9

Inspection of Nineteen Cities' Supply — Concluded.

	Number of Samples taken.	Number of Samples below Standard.	Number of Samples containing Less than 12 Per Cent. of Solids.
Newburyport,	26	3	–
Newton,	85	35	10
Quincy,	12	–	–
Salem,	71	30	10
Somerville,	86	47	18
Waltham,	36	12	6
Woburn,	23	9	1
Worcester,	24	20	5
Totals,	1,224	591	200
Percentages,	–	48	16

Inspection of Sixteen Towns' Supply.

Clinton,	8	8	8
Cottage City,	13	7	2
Greenfield,	12	1	1
Hingham,	65	21	9
Hyde Park,	9	7	1
Marlborough,	58	28	15
Medford,	12	4	1
Natick,	11	1	1
North Adams,	9	6	3
Plymouth,	12	–	–
Provincetown,	12	3	3
Revere,	9	6	–
South Framingham,	12	6	2
Stoneham,	8	5	–
Wakefield,	16	11	8
Watertown,	23	9	1
Totals,	277	121	50
Percentages,	–	43	18

Samples from Suspected Producers.

Andover,	12	6	6
Ashland,	7	5	4
Berlin,	10	7	3
Boylston,	5	4	4
Chelmsford,	15	9	2
Concord,	33	19	6
Cordaville,	21	14	0
Dracut,	12	3	0
Grafton,	12	9	3
Harvard,	2	2	2

Samples from Suspected Producers — Concluded.

	Number of Samples taken.	Number of Samples below Standard.	Number of Samples containing Less than 12 Per Cent. of Solids
Lancaster,	6	5	2
Lexington,	33	30	20
Lincoln,	10	2	1
Needham,	16	7	2
Princeton,	7	7	3
Southborough,	7	6	5
Sterling,	7	4	2
Stow,	6	5	1
Sudbury,	6	4	2
Wayland,	30	14	9
Waltham,	4	1	0
Totals,	261	163	77
Percentages,	–	60	29

Samples from Town Farms.

Holliston,	7	6	0
Salem,	8	5	2
Wakefield,	5	5	2
Warren,	10	7	0
Totals,	30	23	4
Percentages,	–	76	13

Samples of Known Purity. Series from one Herd.

January,	16	3	1
February,	16	2	0
March,	32	5	2
April,	16	4	0
May,	32	2	2
June,	31	6	6
July,	16	11	4
August,	32	15	4
September,	32	11	1
October,	16	3	0
November,	32	8	1
December,	22	7	2
Totals,	303	77	23
Percentages,	–	25	7

Other Samples of Known Purity.

	Number of Samples taken.	Number of Samples below Standard.	Number of Samples containing Less than 12 Per Cent. of Solids.
Andover, ...	16	15	11
Brockton, ...	12	6	1
Totals, ...	28	21	12
Percentages, ...	–	75	42

Respectfully submitted,

CHARLES P. WORCESTER.

PROFESSOR GOESSMANN'S REPORT.

WESTERN MASSACHUSETTS.

The following report comprises the results of examinations of milk obtained in the cities and towns of western Massachusetts by the State Board of Health during the year ending Sept. 30, 1890: —

The whole number of samples examined was	270
The number above the standard was	209
The number below the standard was	61
The percentage of samples below the standard was . . .	22.6

The percentage of samples found to be below the legal standard was slightly greater than was found in the examinations of the previous year.

The statistics relating to the examinations of the milk obtained from cities and towns in the four western counties are presented in the following table: —

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.
Chicopee, ...	36	29	7	19.44	6
Greenfield, ...	12	10	2	16.66	–
Holyoke, ...	36	28	8	22.22	–
North Adams, . . .	24	17	7	29.16	2
Northampton, . . .	24	20	4	16.66	3
Orange, ...	7	5	2	28.59	–
Pittsfield, ...	12	11	1	8.33	–
Shelburne Falls, . .	10	9	1	10.00	–
Springfield, ...	73	52	21	28.76	1
Turner's Falls, . . .	12	9	3	25.00	–
Ware, ...	12	11	1	8.33	–
Westfield, ...	12	8	4	33.33	–
Totals, . . .	270	209	61	22.59	12

CHARLES A. GOESSMANN.

REPORT OF THE ANALYST OF DRUGS.

DR. DAVENPORT'S REPORT UPON DRUGS.

Boston, Oct. 1, 1890.

Dr. S. W. Abbott, *Secretary State Board of Health.*

Sir : — I have the following report to make upon the 400 samples of drugs which were submitted to me for examination during the past twelve months. Of these, 75, or 18.75 per cent., were found not to be of their proper standard quality as called for by the laws of Massachusetts relating to food and drugs.

Among the drugs examined were 7 samples of powdered opium, which, assayed by the official method, yielded the following per cents. of morphia : —

Between	12.5	and	12.6	per cent.	of morphia,	1	sample.
“	12.4	“	12.5	“	“	1	“
“	12.3	“	12.4	“	“	1	“
“	12.0	“	12.1	“	“	1	“
“	11.6	“	11.7	“	“	1	“
“	11.3	“	11.8	“	“	1	“
“	10.7	“	10.8	“	“	1	“

Of tincture of opium the 30 samples examined by the above method of assay were found to yield : —

Between	1.20	and	1.30	per cent.	of morphia,	7	samples.
“	1.10	“	1.20	“	“	10	“
“	1.00	“	1.10	“	“	3	“
“	0.90	“	1.00	“	“	5	“
“	0.80	“	0.90	“	“	5	“

The 1 sample of apomorphia, and the 2 samples of powder of opium and ipecac, which were examined, were all found to be of standard quality.

Of the 31 samples of simple salts of cinchona alkaloids all were found to be of standard quality, while with the compound salts of citrate of iron and quinine the following yields were obtained upon assay of the scales : —

Between	12	and	13	per cent. of alkaloid,	15	samples.
"	11	"	12	"	"	10	"
"	8	"	9	"	"	1	"

while the single sample of the salt in solution proved to contain but the one-eighth part of the proper quantity of the alkaloid, this year's experience in this respect thus being similar to preceding ones.

With the 11 samples of tincture of nux vomica the following results were obtained : —

Between	2.50	and	3.00	per cent. of extract	in	3	samples.
"	2.00	"	2.50	"	"	5	"
"	1.50	"	2.00	"	"	1	"
"	1.00	"	1.50	"	"	1	"
"	0.50	"	1.00	"	"	1	"

There were 15 samples of iodoform, 7 of chloroform, 3 of alcohol and 11 of stronger ether, all of which proved to be of proper quality. The 2 samples of distilled water proved to be simple tap water. Of the 10 samples of simple syrup 6 proved to be markedly deficient in sugar, averaging in fact hardly half of the proper amount. Of 9 samples of compound spirits of ether but 2 had in any approximate degree the proper proportions of the very important ingredient, heavy oil of wine. Of 14 samples of spirits of nitrous ether but 7 at all approached the proper proportions of ethyl nitrite, while the other 7 had less than one-quarter of that amount. The 17 samples of chloral hydrate were all of standard quality. Of the distilled spirits, whiskey and brandy, 4 samples were examined, and all, as has happened in previous years, have proved not to be of the special quality called for under the drug law for use in medicine. They had all, in short, been "improved" or manufactured by the arts of the rectifier, while the law in this particular instance allows of no other "improvement" in the straight distilled spirit from fermented grain or grape than that effected by nature alone in time.

In this connection an article in a recent number of the American Druggist upon an exhaustive report lately made by Prof. W. Fresenius in his Zeitschrift für Analytische Chemie upon the composition and constituents of distilled spirits is of interest. It says: "It is quite certain that only a very minute proportion of the distilled spirits, as they appear in the market, actually correspond to the definition of 'pure distillates from their respective fermented mashes.'" "As the addition of a small proportion of cane sugar is universally conceded to result in an improvement of the taste of brandy, it cannot on its own account be objected to. The question is only whether Cognac thus 'improved' is still to be called or recognized as Cognac or brandy, or whether it is to be classed among compound liquors (cordials, liqueurs), although commercial custom has up to the present retained the name of Cognac for this 'compound' article. The German custom authorities, however, often fail to accept this view. In consequence thereof French exporters have adopted the plan of sending the pure 'unimproved' brandy by itself, and, separate from it, the requisite improving liquid (coloring matter, probably accompanied by certain aromatic essences)." He says further, "while the 'improvements' thus far outlined — addition of water, coloring matter and sugar — are, to a certain extent, allowable, there is another manipulation which goes beyond this limit; this is the addition of spirit and the subsequent reduction with water, both of which are very commonly practised." With this addition of spirit begins a class, or series of changes, which form a gradual transition, indefinable as to the exact limits from the genuine to the adulterated brandy, and to its absolute imitation, in which latter there is not even a trace of the genuine distillate.

In proportion as the addition of spirit increases and the genuine distillate decreases, there is a diminution of the aroma, which is usually replaced by so-called Cognac essences or other aromatic compounds; moreover, it becomes necessary to add more coloring matter and sugar. An interesting but not generally known fact has been communicated to Professor Fresenius by Mr. Schmoelder of Frankfort, namely, that the best Cognac is not always obtained from the best vintages or "wine years," but that other ordinary and even inferior vintages may yield the best Cognac. This is due to the fact that a less quantity of a strong wine is required to yield a given measure of brandy of a certain strength; thus the brandy obtained from a weaker wine may contain a greater concentration of the aromatic principles.

Professor Fresenius further discusses at considerable length, taking the negative side, whether, as some authorities seem inclined to so regard it, a brandy which has been compounded or improved by the addition of aromatics and then redistilled, or has otherwise been manipulated, can still be justly regarded as a "distillation product from wine." He concludes that all other than that of the quality of the Pharmacopœia is to be considered as an artificial or manufactured brandy.

As to the quality of the Cognac brandy when imported direct from France and sold, as the law directs, "as pure and unadulterated as when imported," the following extract from the December, 1888, report to the United States Department of State of O. Malmros, the United States Consul at Cognac, the commercial centre of the trade, may give some useful information. Cognac brandy, he says, is divided into two principal classes, "the champagnes," made from wine grown upon the plains cultivated from remote antiquity, and the "bois," grown on territory which until the present century mostly abounded in trees; this last is subdivided into "premiers," "fin," "bons," "ordinaire" and lastly "à terroir," which, on account of its strong unpleasant taste, cannot be employed except in very small proportions for blending with other brandies, without injury to their flavor. The sandy, waste district producing this most inferior brand he says has suffered but little from the phylloxera, while in the remainder of the "bois" district its ravages have been formidable; but the vineyards of the "champagne" country have been entirely destroyed, and no champagne brandy has been distilled since the year 1878, when the phylloxera first made its appearance in the valley of the Charente River.

"Although the home consumption of Cognac in France has not diminished at all during the past ten years, the production has hardly equalled the one-ninth of that of an average year before the phylloxera commenced, yet the exportations have declined only one-half. About fifty per cent. of all the brandies exported to the United States are invoiced at 300 francs per hectolitre, or under, while the average cost at which newly distilled pure brandy of standard strength may be imported into the United States, on the basis of 100 francs per barrel of wine of two hectolitres, M. Malmros states to be over 560 francs. From a comparison of these amounts one may, he thinks, infer the probable purity of the brandy imported. He has not, however, the slightest doubt that the great majority of the Cognac merchants furnish as good and pure an article as the prices their customers are willing to pay enables them to furnish."

As whiskey was not among the distilled spirits examined by Professor Fresenius the following extract from a report by C. Richardson, a chemist of the United States Department of Agriculture, is instructive. His samples of "straight whiskey" were obtained directly from the United States bonded warehouse, through the United States commissioner of internal revenue; his commercial samples were from reputable wholesale and retail dealers. He says: "Very few straight whiskeys are sold as such in America, it having been found desirable from a commercial point of view to mix the products of different fermentations or mashes which have a different flavor, to add artificial flavoring materials, such as tea, spices and sugar, and often to reduce the strength with water." His results show that upon the average the commercial samples contained over twenty times as much total solids as did the natural ones. Herein his results agree with my own, as shown in previous reports.

Of wines five samples were examined, and among them three were found not to be the natural article called for by the standard of the drug law, but they had, like the samples of distilled spirits, been "improved."

In Spain, according to the royal decree of Jan. 30, 1888, concerning wines, based upon the report of the Royal Academy of Medicines and the Royal Council of Health, all wines are to be considered as adulterated which contain imperfectly rectified industrial alcohol, or impure alcohol from the residue or mash of grapes, which contain salicylic acid or other antiseptic substance, which contain any vegetable coal tar or other foreign coloring matter, which contain any glucose or starch sugar, or new wine, or any foreign glycerine.

The true sherry district is a territory of only about a dozen miles square, and is included within the towns of Port St. Mary's and Jerez, the chamber of commerce of which rules that all wines containing anything foreign to the pure must of the grape is to be deemed as adulterated. The United States Consul at Cadiz, in his report to the State Department concerning the quality of wine shipped from that port, says of New York that " the largest quantity consumed there is of very low grade." And, " In general, the low-priced sherries are blended or compounded of four or more different sorts, viz : alcohol, sweet wine, in which the fermentation has been checked by a large addition of alcohol ; colored wine, cheap new wines of different kinds, and sometimes of a few gallons of older wine, to help the whole to an older appearance."

Of 17 samples of pharmacopœial salts of bismuth and 7 of magnesia, 1 cream of tartar, 1 cocoa butter, and 27 U. S. P. acids all proved to be of standard quality, as did also 24 different spices, 6 starches, 2 rhubarbs and 10 lycopodiums.

One sample of olive oil proved to be mostly cotton-seed oil, and one of musk proved to contain very little of that substance. Out of 13 samples of the pharmacopœial essential oils all but 1 proved to be of fairly good quality, while out of 33 samples of the solid extracts 9 were not of standard quality.

Of honey 11 samples, of glycerine 14, and of lemon juice 1, were all good, while of pepsin 2 samples had only 1 of proper quality. Of proprietary articles the following were examined : a hair dye which was found free from any injurious substance, while Radam's Microbe Killer appears to be principally a watery solution of burning sulphur fumes which had become decomposed into quite a strong solution of sulphuric acid. It seems to be flavored and partially disguised by the addition of some little sweet red wine. Its claim for originality and as a panacea for all ills would therefore seem to have only about the usual basis for such pretensions. Ozonos as a fairly strong solution of a permanganate has much more efficacy than originality as a disinfectant. The like could well be said of Modene, which was found to be one of the well-known sulphides which has been used for centuries for the removal of superfluous hair from the skin.

BENNETT F. DAVENPORT,

Analyst.

MORTALITY REPORTS.

WEEKLY MORTALITY—REPORTS OF CITIES AND TOWNS.

It has been the custom of the Board, almost from its organization, to collect from each of the cities and large towns (and such of the smaller towns as have voluntarily sent them) the returns of deaths obtained in each municipality during the preceding week. These have been published weekly by the Board in a bulletin, a copy of which has been forwarded to the town clerks and registrars of each city and town.

This summary has furnished an important index of the prevalence of the principal infectious diseases in the State, and although not so complete as the returns furnished in the Registration reports, the weekly returns of mortality may be taken as a reasonably reliable history of the health of the people from week to week throughout the year.

The principal point of interest which stands out prominently in the returns of 1890 is the increased mortality from respiratory diseases, which occurred coincidently with the epidemic of influenza in January, 1890.

This epidemic was made the subject of a special paper in the last annual report, in which it was shown that not less than three-fourths of a million of the inhabitants of the State suffered from the epidemic to a greater or less degree. It was also estimated that not far from twenty-five hundred persons lost their lives by the epidemic.

It appears, however, that the losses by other diseases were less numerous during the remaining months, so that the general mortality for the year was not very greatly increased. The epidemic undoubtedly proved fatal to many persons of weak and enfeebled constitutions, and especially to tuberculous persons, who would in all probability have died later in the year.

The report of the year 1890 has the advantage of being made up from the statistics of a census year, so that its ratios are more correct than those of intervening years, in which estimates of population only can be employed. The population contributing to these returns, mainly that of cities and large towns, was about 1,150,000.

The data embraced in this report are included in the following table, and comprise the following particulars: they relate to those diseases which are of special sanitary significance, a large portion of which are considered as either infectious, communicable or preventable diseases; to these are also added such meteorological data as are essential.

Average height of barometer for each week.
Mean of daily maximum temperature.
Mean of daily minimum temperature.
Rainfall in inches.
Humidity.
Total deaths reported for each week.
Deaths of children under five years.
Deaths from infectious diseases.
Deaths from consumption.
Deaths from acute lung diseases.
Deaths from typhoid fever.
Deaths from diarrhœal diseases.
Deaths from scarlet-fever.
Deaths from measles.
Deaths from diphtheria and croup.
Deaths from puerperal fever.
Deaths from whooping-cough.
Deaths from malarial fever.
Deaths from small-pox.
Deaths from erysipelas.

General Summary.

DATE.	Barometer.	Maximum Thermometer. Mean for each week.	Minimum Thermometer. Mean for each week.	Rain — Inches.	Humidity. Mean for each week.	Total Deaths.	Deaths under Five Years of Age.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.	Scarlet-fever.	Measles.	Diphtheria and Croup.	Whooping-cough.	Malarial Fever.	Small-pox.	Erysipelas.	Puerperal Fever.	Death Rate per 1,000.
Jan. 4,	30.40	46	29	.04	67	603	145	130	167	9	2	3	-	44	4	1	-	-	-	30.29
11,	29.96	37	21	.57	82	776	177	117	255	8	9	2	1	30	2	-	-	-	-	37.03
18,	30.21	46	25	.76	70	811	170	115	277	5	9	5	-	33	9	-	-	1	-	35.78
25,	30.01	37	22	.07	71	580	140	49	151	4	9	1	-	33	-	-	-	1	-	28.29
Feb. 1,	30.07	40	24	.70	72	521	122	79	102	5	7	3	-	27	3	-	-	3	-	22.23
8,	30.12	44	25	.60	76	367	87	63	57	5	3	1	-	16	2	-	-	-	-	20.95
15,	30.17	45	27	.24	70	455	133	50	75	11	2	1	-	36	4	1	-	1	-	21.09
22,	30.02	32	17	.87	-	457	152	65	77	6	6	-	-	31	8	-	-	1	-	21.43
March 1,	30.01	45	33	.88	-	412	141	69	75	2	5	4	1	6	4	-	-	-	-	20.73
8,	30.11	31	16	1.32	-	374	118	49	56	4	7	-	1	22	7	-	-	2	-	20.62
15,	30.31	49	33	1.19	-	457	159	68	92	5	8	3	-	20	6	-	-	-	-	21.43
22,	29.57	44	28	1.71	-	466	148	78	81	7	7	3	1	17	3	-	-	2	-	21.92
29,	29.79	44	31	1.95	-	481	153	58	77	7	4	2	1	20	4	-	-	-	-	21.22
April 5,	30.09	51	34	.17	-	438	143	68	47	3	8	4	-	16	3	-	-	1	-	20.84
12,	29.92	50	36	1.13	-	438	157	63	71	5	6	3	1	28	5	-	-	5	3	20.02
19,	30.05	55	37	.01	-	457	160	50	96	3	8	-	-	21	1	1	-	1	1	20.51
26,	30.14	58	42	.19	-	466	153	69	79	7	9	6	1	21	4	-	-	1	2	20.91
May 3,	30.02	59	42	1.01	-	441	136	59	95	5	8	-	-	13	1	1	-	3	-	20.04
10,	29.89	65	49	2.04	-	469	130	70	64	6	7	6	1	27	-	-	-	1	1	21.59
17,	29.94	67	49	.89	-	459	127	63	63	1	6	7	1	16	1	-	-	2	2	27.92
24,	30.09	64	48	.28	-	401	147	65	31	4	5	4	1	22	4	-	-	3	1	18.42
31,	29.85	69	50	1.14	73	382	130	55	48	9	2	3	1	21	1	1	-	-	-	17.30
June 7,	29.96	69	53	.73	-	368	99	57	37	6	10	1	3	12	3	-	-	1	-	17.21
14,	30.05	73	54	1.00	-	393	108	67	30	1	5	2	3	17	3	-	1	-	2	18.20
21,	30.06	74	57	.00	-	367	107	49	39	8	13	2	1	14	3	-	-	1	1	16.34
28,	29.87	74	60	.13	72	349	127	61	27	6	17	1	2	16	1	1	-	1	-	16.40
July 5,	29.90	78	64	.08	72	382	149	56	33	7	36	3	1	17	7	-	-	-	-	17.30
12,	30.01	77	59	.00	59	521	238	60	27	3	110	1	1	17	7	-	-	2	-	24.06
19,	29.98	81	63	.07	60	546	285	56	19	3	150	-	1	9	3	-	-	1	-	24.73
26,	30.02	74	59	1.54	71	538	265	42	20	5	160	1	3	13	1	-	-	2	2	24.05

Aug. 2, . . .	30.07	82	68	.37	72	717	441	55	26	9	265	2	2	11	7	–	–	1	–	33.63
9, . . .	30.10	81	67	.35	76	707	416	63	11	8	263	3	1	4	8	–	–	–	–	31.10
16, . . .	29.99	76	60	.07	65	628	341	67	34	5	198	1	–	6	6	1	–	–	1	27.70
23, . . .	30.04	75	62	1.11	83	555	274	42	19	10	152	4	–	9	7	1	–	1	1	25.14
30, . . .	29.85	74	58	.95	75	526	283	57	38	11	132	–	–	17	4	–	–	2	–	23.93
Sept. 6, . . .	30.14	74	58	1.51	65	483	234	44	29	19	90	1	–	19	6	–	–	–	–	22.14
13, . . .	30.20	70	61	1.59	86	496	231	58	31	13	97	1	2	12	7	–	–	–	–	21.36
20, . . .	30.00	72	61	1.56	83	482	216	60	19	19	84	1	–	5	2	2	–	–	1	20.78
27, . . .	30.08	66	52	.20	71	439	195	62	12	15	66	4	2	13	6	–	–	–	–	18.76
Oct. 4, . . .	30.19	66	52	1.06	76	398	151	53	18	16	46	–	–	16	1	–	–	–	–	17.01
11, . . .	29.97	59	48	.45	76	402	149	53	27	6	37	1	–	18	–	2	–	1	1	17.48
18, . . .	29.88	59	46	1.09	76	411	133	47	33	19	34	2	–	12	6	–	–	2	1	17.42
25, . . .	30.09	49	42	2.33	84	385	129	46	44	15	26	2	–	15	2	–	–	–	–	16.11
Nov. 1, . . .	30.95	49	39	.20	77	405	112	61	30	16	14	4	1	17	2	1	–	1	–	17.51
8, . . .	30.02	55	40	–	78	390	112	44	33	19	13	2	–	11	1	1	–	1	1	17.49
15, . . .	30.22	51	36	.52	84	411	129	62	62	17	10	2	2	15	–	–	–	–	–	17.30
22, . . .	29.87	49	37	.71	73	391	95	31	67	19	4	–	2	14	5	–	–	1	2	16.90
29, . . .	29.99	38	25	–	67	387	121	45	47	19	6	1	1	12	–	1	–	–	1	16.84
Dec. 6, . . .	29.98	34	19	.93	77	436	108	66	44	10	6	5	2	21	1	–	–	1	–	18.40
13, . . .	29.89	34	17	–	75	451	121	69	73	16	7	4	2	17	–	–	–	2	2	18.96
20, . . .	30.12	36	21	1.31	73	441	118	48	75	16	8	–	–	19	–	–	–	2	2	19,70
27, . . .	29.98	37	21	1.36	74	448	124	60	73	19	9	2	2	13	–	1	–	4	–	18.73
Total, . . .	–	–	–	–	–	24,564	8,739	3,193	3,213	476	2,205	114	45	931	175	16	1	55	28	21.38
Weekly average, .	–	–	–	–	–	472	168	61	62	9	42	2	–	18	3	–	–	1	–	–
Rate per 1,000 deaths,	–	–	–	–	–	–	355.77	129.98	130.80	19.33	89.76	4.64	1.87	37.90	7.12	.65	–	2.23	1.14	–
Rate per 1,000 of the estimated reporting population, . .	–	–	–	–	–	21.38	7.6	2.8	2.8	.41	1.9	.1	.04	.8	.15	.01	–	.05	.02	–

Average reporting population, ... 1,148,900

TOTAL DEATHS.

The whole number of deaths reported for the year 1890 from the cities and towns which contributed to these returns was 24,564, and the average number for each week was 472.

The greatest number of deaths reported in a single week was 811, in the week ending with January 18, and the least number reported was 349, in the week ending June 28. The date of this maximum differs from that of other years, and was due to the effect of the serious epidemic of influenza, which was fully treated in the last annual report (p. 307).

The weekly average number of deaths reported for each month was as follows: —

January,	692	July,	497
February,	450	August,	570
March,	433	September,	475
April,	450	October,	399
May,	430	November,	397
June,	369	December,	355

The months in which the greatest numbers of deaths were reported were January, August and July, and those in which the least numbers were reported were December, June and November.

Of the total number of deaths reported, the percentages of mortality in each quarter of the year were as follows: —

	All Ages.		Ages under 5 Years.	
	Numbers.	Percentages.	Numbers.	Percentages.
First quarter,	6,760	27.52	1,845	21.11
Second quarter,	5,428	22.10	1,724	19.73
Third quarter,	7,020	28.58	3,568	40.83
Fourth quarter,	5,356	21.80	1,602	18.33
	24,564	100.00	8,739	100.00

The ratios of total deaths in each quarter as compared with the total mortality differed very much from those of the previous year, in which the percentage of mortality in the third quarter greatly exceeded that of either of the other quarters. In the record of 1890 the percentages of mortality in the first and third quarters were nearly equal, while those of the second and fourth quarters were also nearly equal, but much less than those of the first and third.

Deaths under Five Years.

The number of reported deaths of children under five years of age was 8,739, and the weekly average for the year was 168. The greatest number of deaths of this class reported for a single week was 441, in the week ending August 2, and the least number was 87, for the week ending February 8. The ratio of reported deaths of children under five years of age to the total deaths was 35.58 per cent., or one in 2.8, as compared with 34.85 per cent. in 1889, 33.7 in 1887, and 36.6 in 1886.

The average weekly number of deaths of children under five for each month was as follows: —

January,	133	July,	234
February,	123	August,	351
March,	144	September,	219
April,	153	October,	140
May,	134	November,	114
June,	110	December,	118

The months in which the greatest numbers of deaths of this class were reported were July, August and September, and those in which the least numbers were reported were February, June and December.

The percentages of deaths in each quarter of the year did not differ materially from those of 1889, that of the third quarter in each year being very much greater than that of either of the other quarters. The epidemic of influenza did not affect this class of deaths nearly so much as the preceding, *i.e.*, the total mortality. The epidemic produced its most fatal effects in the month of January, and its effects upon the class of adults, or at least upon that portion of the population who were more than five years of age, is shown by the following table: —

	Deaths of Persons over Five Years of Age.	
	Deaths.	Percentages.
First quarter,	4,915	31.06
Second quarter,	3,704	23.41
Third quarter,	3,452	21.81
Fourth quarter,	3,752	23.72
		100.00

CONSUMPTION.

The number of deaths reported from consumption during the year was 3,193, and the weekly average was 61. The greatest number reported from this cause in one week was 130, in the week ending January 4, and the least number 31, in the week ending November 22.

In the first three weeks of January (the three most fatal weeks also of the epidemic of influenza as reported in the twenty-first annual report of the Board), the deaths were successively, 130, 117 and 114, or double the weekly average of the year.

The average weekly number of deaths reported for each month from this cause was as follows: —

January,	103	July,	53
February,	64	August,	57
March,	64	September,	56
April,	62	October,	50
May,	62	November,	49
June,	58	December,	61

The variations from the average weekly numbers for the two years 1889 and 1890 are shown in the following table: —

Departures from the Weekly Average.

	1889.	1890.		1889.	1890.
January,	0	42	July,	—1	—8
February,	4	3	August,	—1	—4
March,	0	3	September,	—3	—5
April,	2	1	October,	0	—11
May,	—1	1	November,	1	—12
June,	—2	—3	December,	0	0

The marked effect of the epidemic, in removing a large number of weak and enfeebled consumptives who would under ordinary circumstances probably have died in the later months of the year, and the consequent disturbing effect upon the ordinary uniform mortality-rate from this disease, is also shown in the foregoing table.

In 1889 there was a variation of only 7 between the maximum and minimum weekly average, while in 1890 the variation amounted to 99.

The ratio of reported deaths from consumption to the total mortality reported from all causes was 130 per 1,000 as compared with 125 in 1889, 134.2 in 1888, 141.1 in 1887 and 156.5 in 1886.

The ratio to the reporting population was 2.78 per 1,000.

ACUTE LUNG DISEASES (*Pneumonia*, *Bronchitis*, *Asthma and Pleurisy*).

The number of deaths reported from this group of cases was 3,213 and the average number for each week was 62. The average weekly number reported for each month was as follows: —

January,	212	July,	25
February,	78	August,	26
March,	76	September,	23
April,	73	October,	31
May,	60	November,	48
June,	33	December,	66

The months having the greatest numbers of reported deaths from these causes were January, February and March. Those of January far exceeded those of either of the remaining months. The months having the least number were July, August and September. The ratio of reported deaths from these causes as compared with the total reported mortality was 130.8 per 1,000, as compared with 106.03 in 1889, 121.8 in 1888 and 107.3 in 1887. The greatest number of reported deaths from these causes in any week was 277, in the week ending January 18, and the least number was 11, in the week ending August 9. The reported deaths for the four weeks ending January 4, 11, 18 and 25 were, respectively, 167, 255, 277 and 151; while for the first four weeks of 1889 they were, respectively, 59, 43, 67 and 54. The mortality-rate as compared with the reporting population was 280 per 1,000.

TYPHOID FEVER.

The number of reported deaths from typhoid fever in 1890 was 476, and the weekly average was 9. The average weekly number reported for each month was as follows: —

January,	6	July,	4
February,	7	August,	9
March,	5	September,	16
April,	4	October,	14
May,	5	November,	18
June,	5	December,	15

The greatest numbers of reported deaths from typhoid fever occurred in the months of September, November and December, and the least numbers in April, June and July.

The ratio of reported deaths from this cause to the total reported mortality from all causes was 19.33 per 1,000 as compared with 20.9 in 1889, 20.7 in 1888 and 20.9 in 1887. The average annual mortality-rate from this cause per 1,000 deaths from all causes for the decade 1861–70 was 46.9, and for the next decade it was 31.7; while for the decade 1881–90 the same ratio was about 23.0 (estimated), a reduction of one-half since 1861, notwithstanding the continued high prevalence in some of the cities having polluted water supplies.

The ratio to the reporting population was .41 per 1,000. The greatest number of reported deaths from this cause in one week was 19 in each of the weeks ending September 6, 19, October 18, November 8, 22 and 29 and December 27, and the least number was 1 in the weeks ending May 17 and June 14.

DIARRHŒAL DISEASES (*Diarrhœa, Dysentery, Cholera Infantum, Cholera and Enteritis*).

The number of deaths reported from these causes in 1890 was 2,205 and the weekly average was 42. The average weekly number reported for each month was as follows: —

January,	7	July,	114
February,	4	August,	202
March,	6	September,	84
April,	8	October,	36
May,	6	November,	9
June,	11	December,	7

The months having the greatest number of reported deaths from these causes were July, August and September, and those having the least number were February and May. The greatest number reported in one week was 265, in the week ending August 2; and the least number was 2, in the weeks ending January 4, February 15 and May 31. The mortality from these causes reported for the last two quarters of 1890 was 91.7 per cent. of the total number reported for the year from the same causes; and for the three months of July, August and September it was 81.9 per cent. The ratio of the mortality from these causes to the total mortality was 89.8 per 1,000, as compared with 87.7 in 1889, 77.9 in 1888 and 82.5 in 1887. The mortality-rate per 1,000 of the estimated population was 1.92.

Scarlet-fever.

The total number of reported deaths from scarlet-fever in 1891 was 114, and the average reported weekly mortality from the same cause was 2. The average weekly mortality as reported for each month was as follows: —

January,	3	July,	1
February,	1	August,	2
March,	2	September,	2
April,	3	October,	1
May,	4	November,	2
June,	2	December,	3

The months having the greatest reported mortality from this cause were April and May, and those having the least were February, July and October.

The ratio of mortality from this cause to the total mortality was the same as that of 1889, viz., 4.6 per 1,000, both being much lower than that of any previous year. That of 1888 was 11.2, of 1887, 14.4 and of 1886, 8.7.

The ratio for the thirty years ending 1888 was 28.9 per 1,000, and the lowest ratio of any year of that period was 8.7. The actual number of deaths from this cause in 1872, '73, '74, '75 and '76 were 1,377, 1,472, 1,382, 1,684 and 1,222.

The greatest number of deaths reported from this cause in any one week was 7 in the week ending May 17, and there were no deaths from the same cause in the weeks ending February 22, March 8, April 19, May 3, July 19, August 30, October 4, November 22 and December 20.

The ratio to the estimated reporting population was .09 per 1,000.

MEASLES.

The total number of deaths reported from this cause in 1890 was 45, and the average weekly mortality was 1.

The average weekly mortality from this cause as reported for each month was as follows: —

January,	–	July,	2
February,	–	August,	1
March,	1	September,	1
April,	1	October,	–
May,	1	November,	1
June,	2	December,	2

The months having the greatest number of reported deaths from this cause were June, July, November and December. There were no deaths reported from measles in February and October.

The ratio of mortality from measles to the total mortality was 1.9 per 1,000 as compared with 3.6 per 1,000 in 1889 and 2.8 in 1888. The ratio to the estimated reporting population was .039 per 1,000.

DIPHTHERIA AND CROUP.

The total number of deaths reported from these causes was 931, and the average number per week was 18. The average weekly number reported in each month was as follows: —

January,	35	July,	14
February,	27	August,	9
March,	17	September,	12
April,	21	October,	15
May,	20	November,	14
June,	15	December,	18

The greatest number of reported deaths occurred in the months of January and February, and the least in August and September.

The greatest number of reported deaths from this cause in one week was 44, in the week ending January 4, and the least number 5, in the week ending September 20.

The ratio of mortality from these causes to the total mortality was 37.9 as compared with 56.9 in 1889, 53.6 in 1888 and 41.2 in 1887. The ratio to the reporting population was .81 per 1,000.

WHOOPING-COUGH, ERYSIPELAS, PUERPERAL FEVER, MALARIAL FEVER AND SMALL-POX.

The total number of deaths reported from these causes in 1890 from the reporting cities and towns was as follows: —

	Total Deaths reported.	Weekly Average.	Ratio per 1,000 reported Deaths from all Causes.	Ratio per 1,000 of the Estimated Population.
Whooping-cough,	175	3.4	7.1	.15
Erysipelas,	55	1.0	2.2	.05
Puerperal fever,	28	0.5	1.1	.02
Malarial fever,	16	0.3	0.6	.01
Small-pox,	1	0.02	0.04	.0008

The reported mortality from whooping-cough was less than that of 1889 and greater than that of 1888. The reported deaths from erysipelas and puerperal fever were in each instance greater than those of 1889, but less than those of 1888.

The reported deaths from malarial fever were greater in number than those of either 1888 or 1889.

There was but one reported death from small-pox in 1890.

MORTALITY OF CITIES.

The following tables present the mortality-rates of cities for each week during the year 1890, so far as can be obtained from the voluntary reports sent to the office of the State Board of Health during the year.

The data furnished are expressed in the following tables as a ratio per 10,000 of the living population, the calculation being made upon the population of the United States Census of 1890.

The value of these voluntary returns to the State Board of Health is yearly increasing. The majority of the cities send them punctually, while others send none. These reports have proved to be of great value during the past two years in tracing the history and progress of infectious diseases in different cities and towns, with a view to their prevention; and it would render the work of preventive medicine much more efficient if the co-operation of the State and local boards could be secured in this direction by legal enactment, at least so far as concerns the cities and large towns.

Mortality-rates of Cities.

1890. WEEK ENDING—	Boston.	Worcester.	Lowell.	**1890.** WEEK ENDING—	Boston.	Worcester.	Lowell.
Jan. 4,	40.37	11.70	22.81	July 5,	16.94	11.70	26.84
11,	48.26	15.40	32.21	12,	22.50	19.09	27.51
18,	40.02	25.25	44.96	19,	25.40	19.09	37.57
25,	24.82	14.78	43.61	26,	21.34	23.41	35.56
Feb. 1,	22.27	20.94	34.22	Aug. 2,	32.94	33.88	34.22
8,	19.60	11.08	19.40	9,	32.24	16.63	37.57
15,	22.27	16.02	27.51	16,	28.07	20.94	30.86
22,	23.32	14.78	17.44	23,	23.20	18.48	24.15
March 1,	21.46	15.40	19.40	30,	23.78	19.71	28.18
8,	19.60	19.71	24.15	Sept. 6,	22.15	19.71	26.16
15,	23.20	19.71	20.80	13,	22.50	12.94	25.49
22,	25.17	16.02	20.80	20,	19.50	12.94	30.86
29,	23.43	19.09	18.78	27,	19.14	15.40	20.80
April 5,	19.60	23.41	20.13	Oct. 4,	19.25	9.85	20.13
12,	20.07	15.40	21.47	11,	17.75	9.85	22.14
19,	20.76	19.71	28.86	18,	20.53	8.62	16.10
26,	24.24	14.78	24.16	25,	18.91	14.78	16.77
May 3,	20.76	9.85	25.49	Nov. 1,	20.65	8.62	22.14
10,	23.55	14.17	31.53	8,	20.18	10.47	16.10
17,	21.57	18.48	20.13	15,	18.33	7.39	22.14
24,	20.65	9.85	20.13	22,	19.84	12.94	20.80
31,	17.86	10.47	22.81	29,	18.44	9.85	25.49
June 7,	17.98	8.62	18.78	Dec. 6,	21.58	15.40	21.47
14,	20.30	9.85	13.42	13,	23.55	14.78	28.85
21,	19.25	16.02	21.47	20,	21.35	12.32	22.81
28,	16.24	15.40	20.13	27,	21.69	19.71	28.85

Population of Boston,	448,477
Total deaths,	10,126
Death-rate, 1890,	22.58
Population of Worcester,	84,655
Total deaths,	1,495
Death-rate, 1890,	17.54
Population of Lowell,	77,696
Total deaths,	1,960
Death-rate, 1890,	25.23

Mortality-rates of Cities — Continued.

1890. WEEK ENDING —	Fall River.	Cambridge.	Lynn.	1890. WEEK ENDING —	Fall River.	Cambridge.	Lynn.
Jan. 4,	13.32	28.30	20.52	July 5,	13.32	11.92	18.66
11,	26.64	29.69	28.08	12,	39.27	21.60	27.14
18,	30.85	26.81	27.14	19,	33.65	24.58	13.10
25,	35.76	16.39	20.52	26,	35.76	17.88	11.23
Feb. 1,	18.23	16.39	12.17	Aug. 2,	33.65	25.32	21.46
8,	25.94	22.35	23.32	9,	32.25	24.58	26.17
15,	25.94	14.89	15.91	16,	28.05	20.11	28.08
22,	33.66	6.70	14.04	23,	23.14	21.60	21.46
March 1,	19.63	11.17	14.97	30,	25.94	23.09	15.91
8,	25.24	12.66	16.85	Sept. 6,	16.82	20.85	13.10
15,	21.03	17.88	18.72	13,	22.43	18.62	20.52
22,	23.14	13.41	14.04	20,	27.34	25.32	16.85
29,	20.33	16.39	13.10	27,	22.43	13.41	14.04
April 5,	16.13	18.62	20.52	Oct. 4,	21.74	12.66	10.29
12,	22.43	15.64	12.17	11,	23.14	12.66	16.85
19,	17.53	21.60	16.85	18,	20.33	14.89	18.66
26,	23.14	10.43	13.10	25,	23.14	11.92	13.10
May 3,	18.23	16.39	11.23	Nov. 1,	21.74	10.43	17.78
10,	13.32	13.41	14.97	8,	21.03	20.11	23.32
17,	16.82	20.85	12.17	15,	18.93	17.88	21.46
24,	14.72	17.88	16.85	22,	14.72	12.66	14.04
31,	18.23	12.66	15.91	29,	16.82	10.43	16.85
June 7,	17.53	14.89	21.46	Dec. 6,	18.23	14.15	18.66
14,	16.82	14.89	15.91	13,	19.63	15.64	15.91
21,	11.92	14.15	8.42	20,	14.72	17.88	21.46
28,	19.63	16.39	4.68	27,	17.53	13.41	10.29

Population of Fall River,	74,398
Total deaths,	1,705
Death-rate, 1890,	22.91
Population of Cambridge,	70,028
Total deaths,	1,240
Death-rate, 1890,	17.70
Population of Lynn,	55,727
Total deaths,	984
Death-rate, 1890,	17.66

Mortality-rates of Cities — Continued.

1890. Week ending —	Lawrence.	Springfield.	New Bedford.	1890. Week ending —	Lawrence.	Springfield.	New Bedford.
Jan. 4,	25.61	30.60	20.44	July 5,	33.76	24.71	16.59
11,	37.26	18.83	25.55	12,	34.93	20.00	25.55
18,	37.26	43.54	30.66	19,	36.09	12.94	19.14
25,	52.56	36.48	25.55	26,	48.90	22.36	22.99
Feb. 1,	38.42	29.42	26.82	Aug. 2,	34.93	31.77	29.36
8,	24.45	18.83	20.44	9,	33.76	20.00	28.08
15,	19.79	14.12	26.82	16,	18.63	24.71	31.91
22,	38.42	18.83	15.32	23,	33.76	20.00	26.82
March 1,	26.78	18.83	22.99	30,	16.30	16.47	25.55
8,	16.39	15.30	15.32	Sept 6,	22.12	15.30	21.70
15,	25.61	20.00	16.59	13,	27.94	23.54	13.04
22,	25.61	28.24	20.44	20,	29.11	15.30	24.25
29,	33.76	17.65	20.44	27,	20.95	16.47	17.87
April 5,	27.94	16.47	24.25	Oct. 4,	23.28	10.59	11.48
12,	15.13	24.71	17.87	11,	30.27	16.47	8.93
19,	16.30	18.83	24.25	18,	26.78	16.47	16.59
26,	27.94	15.30	16.59	25,	22.12	12.94	5.10
May 3,	11.64	18.83	24.25	Nov. 1,	16.30	17.65	17.87
10,	20.95	21.71	21.70	8,	12.80	11.77	21.70
17,	22.12	14.12	24.25	15,	25.61	18.83	13.04
24,	10.47	14.12	26.82	22,	26.78	12.94	13.04
31,	18.63	15.30	12.76	29,	10.47	16.47	20.44
June 7,	24.45	14.12	12.76	Dec. 6,	17.46	22.36	16.59
14,	22.12	18.83	16.59	13,	20.95	17.65	6.38
21,	9.31	22.36	13.04	20,	31.43	20.00	22.99
28,	15.13	20.00	19.14	27,	24.45	9.41	16.59

Population of Lawrence,	44,654
Total deaths,	1,184
Death-rate, 1890,	26.51
Population of Springfield,	44,179
Total deaths,	861
Death-rate, 1890,	19.49
Population of New Bedford,	40,733
Total deaths,	839
Death-rate, 1890,	20.35

Mortality-rates of Cities — Continued.

1890. Week ending —	Salem.	Chelsea.	Haverhill.	1890. Week ending —	Salem.	Chelsea.	Haverhill.
Jan. 4, .	27.00	26.08	26.55	July 5, .	30.38	11.17	20.86
11, .	43.88	20.49	11.38	12, .	25.32	18.63	17.07
18, .	33.76	35.39	32.04	19, .	15.19	29.80	32.04
25, .	32.07	20.49	22.76	26, .	20.25	14.90	13.27
Feb. 1, .	25.32	20.49	26.55	Aug. 2, .	45.57	33.53	26.55
8, .	20.25	16.76	30.35	9, .	48.97	24.31	28.42
15, .	13.50	16.76	11.38	16, .	33.76	22.35	13.27
22, .	11.81	29.80	11.38	23, .	35.44	24.31	26.55
March 1, .	15.19	11.17	17.07	30, .	30.38	40.98	22.76
8, .	16.88	20.49	13.27	Sept. 6, .	28.69	14.90	11.38
15, .	23.63	18.63	11.38	13, .	27.00	18.63	20.86
22, .	11.81	16.76	11.38	20, .	11.81	18.63	22.76
29, .	20.25	22.35	22.76	27, .	32.07	16.76	17.07
April 5, .	21.94	24.31	18.96	Oct. 4, .	21.94	9.31	37.93
12, .	15.19	22.35	30.35	11, .	35.44	18.63	17.07
19, .	11.81	14.90	13.27	18, .	23.63	13.04	17.07
26, .	21.94	16.76	7.58	25, .	8.44	20.49	26.55
May 3, .	27.00	22.35	28.45	Nov. 1, .	18.56	16.76	15.17
10, .	23.63	18.63	26.55	8, .	20.25	16.76	17.07
17, .	30.38	22.35	15.17	15, .	23.63	7.45	15.17
24, .	11.81	11.17	15.17	22, .	13.50	22.35	3.79
31, .	21.94	18.63	26.55	29, .	18.56	29.80	7.58
June 7, .	15.19	22.35	17.07	Dec. 6, .	18.56	20.49	7.58
14, .	25.32	16.76	13.27	13, .	10.12	13.04	11.38
21, .	13.50	9.13	17.07	20, .	18.56	14.90	9.48
28, .	15.19	16.76	7.58	27, .	20.25	16.76	11.38

Population of Salem, ...	30,801
Total deaths, ...	714
Death-rate, 1890, ...	23.48
Population of Chelsea, ...	27,909
Total deaths, ...	568
Death-rate, 1890, ...	20.35
Population of Haverhill, ...	27,412
Total deaths, ...	518
Death-rate, 1890, ...	18.89

Mortality-rates of Cities — Continued.

1890. Week ending —	Brockton.	Taunton.	Gloucester.	**1890.** Week ending —	Brockton.	Taunton.	Gloucester.
Jan. 4,	7.62	20.43	12.63	July 5,	5.71	10.21	12.63
11,	30.48	26.56	16.84	12,	11.43	10.21	14.74
18,	7.62	26.56	21.06	19,	5.71	16.34	16.84
25,	20.95	34.74	18.95	26,	7.62	36.78	25.27
Feb. 1,	15.24	24.52	8.42	Aug. 2,	19.05	40.87	18.95
8,	9.52	18.39	10.53	9,	34.29	26.56	21.06
15,	24.76	22.47	8.42	16,	13.33	44.95	27.37
22,	7.62	8.17	8.42	23,	26.67	18.39	18.95
March 1,	11.43	14.30	14.74	30,	11.43	18.39	16.84
8,	9.52	26.56	10.53	Sept. 6,	13.33	10.21	18.95
15,	26.67	24.52	8.42	13,	17.14	10.21	12.63
22,	5.71	12.26	8.42	20,	15.24	18.39	25.27
29,	15.24	24.52	6.31	27,	15.24	24.52	18.95
April 5,	15.24	8.17	10.53	Oct. 4,	15.24	18.39	10.53
12,	17.14	30.65	10.53	11,	9.52	14.30	23.16
19,	9.52	14.30	8.42	18,	15.24	6.12	6.31
26,	17.14	16.34	12.63	25,	9.52	10.21	8.42
May 3,	7.62	16.34	10.53	Nov. 1,	19.05	4.08	14.74
10,	13.33	20.43	10.53	8,	17.14	14.30	12.63
17,	15.24	30.65	10.53	15,	11.43	8.17	14.74
24,	17.14	8.17	12.63	22,	17.14	6.12	12.63
31,	20.95	18.39	16.84	29,	15.24	14.30	4.21
June 7,	13.33	16.34	14.74	Dec. 6,	11.43	16.34	8.42
14,	11.43	14.30	8.42	13,	11.43	24.52	8.42
21,	11.43	8.17	6.31	20,	11.43	26.56	6.31
28,	11.43	8.17	10.53	27,	17.14	12.26	6.31

Population of Brockton,	27,294
Total deaths,	444
Death-rate, 1890,	16.27
Population of Taunton,	25,445
Total deaths,	493
Death-rate, 1890,	19.38
Population of Gloucester,	24,651
Total deaths,	424
Death-rate, 1890,	17.20

Mortality-rates of Cities — Continued.

1890. Week ending —		Newton.	Malden.	Fitchburg.	1890. Week ending —		Newton.	Malden.	Fitchburg.
Jan.	4, .	17.16	18.06	2.35	July	5, .	10.66	18.06	11.79
	11, .	40.53	29.35	16.51		12, .	10.66	11.28	7.07
	18, .	21.32	29.35	37.73		19, .	14.93	13.54	7.07
	25, .	38.39	24.83	21.23		26, .	6.39	6.77	7.07
Feb.	1, .	8.53	22.57	23.59	Aug.	2, .	20.32	18.06	7.07
	8, .	12.79	13.54	14.15		9, .	19.19	40.64	9.43
	15, .	6.39	6.77	9.43		16, .	20.32	15.80	23.59
	22, .	12.79	13.54	23.59		23, .	6.39	15.80	7.07
March	1, .	17.16	31.60	18.87		30, .	25.59	9.03	9.43
	8, .	12.79	11.28	18.87	Sept.	6, .	12.79	20.32	11.79
	15, .	8.53	9.03	9.43		13, .	20.32	9.03	21.23
	22, .	8.53	11.28	4.71		20, .	8.53	20.32	21.23
	29, .	8.53	11.28	18.87		27, .	17.16	15.80	16.51
April	5, .	10.66	24.83	16.51	Oct.	4, .	8.53	15.80	21.23
	12, .	14.93	20.32	11.79		11, .	8.53	13.54	21.23
	19, .	12.79	15.80	18.87		18, .	17.16	11.28	11.79
	26, .	19.19	6.77	9.43		25, .	14.93	11.28	9.43
May	3, .	8.53	13.54	11.79	Nov.	1, .	4.26	13.54	16.51
	10, .	14.93	15.80	18.87		8, .	21.32	9.03	21.23
	17, .	12.79	18.06	23.59		15, .	10.66	13.54	11.79
	24, .	19.19	18.06	11.79		22, .	2.13	11.28	9.43
	31, .	0.00	2.25	9.43		29, .	10.66	4.51	21.23
June	7, .	4.26	11.28	11.79	Dec.	6, .	14.93	13.54	16.51
	14, .	14.93	18.06	11.79		13, .	8.53	9.03	7.07
	21, .	8.53	11.28	11.79		20, .	23.46	18.06	11.79
	28, .	6.39	24.83	7.07		27, .	12.79	15.80	21.23

Population of Newton, ...	24,379
Total deaths, ...	333
Death-rate, 1890, ...	13.65
Population of Malden, ...	23,031
Total deaths, ...	369
Death-rate, 1890, ...	16.02
Population of Fitchburg, ...	22,037
Total deaths, ...	323
Death-rate, 1890, ...	14.65

Mortality-rates of Cities — Concluded.

1890. Week ending —		Waltham.	Pittsfield.	Quincy.	Newburyport.	1890. Week ending —		Waltham.	Pittsfield.	Quincy.	Newburyport.
Jan.	4, .	25.01	21.06	18.65	26.09	July	5, .	2.77	9.02	12.44	18.64
	11, .	36.12	18.05	18.65	22.36		12, .	5.55	9.02	15.45	26.09
	18, .	8.33	12.03	27.98	48.46		19, .	11.11	6.01	6.21	14.91
	25, .	13.89	15.04	15.54	29.82		26, .	27.79	6.01	27.98	14.91
Feb.	1, .	13.89	18.05	21.76	33.55	Aug.	2, .	11.11	18.05	43.52	41.00
	8, .	8.33	12.03	21.76	29.82		9, .	25.01	15.04	40.41	33.55
	15, .	11.11	18.05	34.19	29.82		16, .	27.79	18.05	18.65	33.55
	22, .	8.33	9.02	–	33.55		23, .	27.79	15.04	59.07	33.55
March	1, .	30.56	12.03	–	18.64		30, .	13.89	36.10	18.65	18.64
	8, .	16.67	9.02	9.32	26.09	Sept.	6, .	25.01	30.09	43.52	26.09
	15, .	13.89	21.06	15.45	–		13, .	8.33	6.01	21.76	41.00
	22, .	16.67	21.06	9.32	14.91		20, .	13.89	15.04	27.98	26.09
	29, .	2.77	12.03	15.45	22.36		27, .	13.89	15.04	24.87	14.91
April	5, .	16.67	9.02	12.44	18.64	Oct.	4, .	13.89	6.01	6.21	18.64
	12, .	13.89	3.00	15.45	18.64		11, .	5.55	18.05	12.44	22.36
	19, .	13.89	9.02	6.21	29.82		18, .	11.11	6.01	18.65	18 64
	26, .	13.89	9.02	24.87	18.64		25, .	16 67	12.03	12.44	7.45
May	3, .	19.45	21.06	34.19	14.91	Nov.	1, .	13.89	15.04	6.21	26.09
	10, .	2.77	6.01	34.19	18.64		8, .	11.11	12.03	12.44	7.45
	17, .	8.33	12.03	18.65	3.72		15, .	19 45	18.05	15.45	–
	24, .	19.45	15.04	21.76	11.18		22, .	22.23	9.02	12.44	22.36
	31, .	16.67	3.00	9.32	18.64		29, .	16.67	24.07	31.09	11.18
June	7, .	8.33	9.02	6.21	14.91	Dec.	6, .	8.33	6.01	12.44	29.82
	14, .	5.55	9.02	12.44	18.64		13, .	11.11	15.04	6.21	29.82
	21, .	11.11	6.01	15.45	14.91		20, .	19.45	24.07	27.98	18.64
	28, .	8 33	6.01	18.65	7.45		27, .	8.33	21.06	6.21	11.18

Population of Waltham,	18,707
Total deaths,	284
Death-rate, 1890,	15.18
Population of Pittsfield,	17,281
Total deaths,	345
Death-rate, 1890,	19.97
Population of Quincy,	16,723
Total deaths,	355
Death-rate, 1890,	21.23
Population of Newburyport,	13,947
Total deaths,	320
Death-rate, 1890,	22.94

THE GROWTH OF CHILDREN,

STUDIED BY

GALTON'S METHOD OF PERCENTILE GRADES,

By H. P. BOWDITCH, M.D.,
PROFESSOR OF PHYSIOLOGY, HARVARD MEDICAL SCHOOL.

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GALTON'S METHOD OF PERCENTILE GRADES,

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Professor of Physiology, Harvard Medical School.

In the last report of the Massachusetts State Board of Health the advantages of discussing statistical data by Galton's method * of percentile grades were explained and illustrated in a paper entitled "The Physique of Women in Massachusetts." The value of the method in anthropometrical work seemed so obvious that it has been thought desirable to apply it to the large body of observations on the height and weight of Boston school children which formed the basis of an article on "The Growth of Children," published by the Board of Health in 1877.

In this article, at the suggestion of Mr. Charles Roberts, tables were given showing the *distribution* of the observations; *i.e.*, the number of individuals at each age whose height was recorded at each successive inch or whose weight fell within successive groups of four pounds each. From these tables (tables 4 to 15 of the above-mentioned article) it was easy to calculate the values at the various percentile grades. For example, it appears from Table 4 that the heights of 848 boys between five and six years old were distributed as shown in the following table: —

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* See "Galton, Natural Inheritance," London, McMillan & Co., 1889.

Distribution of Observations on Heights of Boston School-boys. Age at Last Birthday Five Years.

Inches.	Number of observations.	Inches.	Number of observations.	Inches.	Number of observations.
47	4	41	190	35	1
46	8	40	149	34	-
45	20	39	79	33	-
44	62	38	42	32	-
43	119	37	17	31	-
42	149	36	7	30	1
Total number of observations, ...					848

In this table it will be seen that five per cent., for instance, of the total number of observations is 42.4. Now since the observations corresponding to each successive inch include all the measurements between that inch and the next inch above, it is evident that there are $1+1+7+17=26$ individuals less than 38 inches in height and $1+1+7+17+42=68$ individuals less than 39 inches in height. Since, therefore, 42.4 lies between 26 and 68 it follows that the height below which five per cent. of the observations fall must be between 38 and 39 inches. The exact height can readily be calculated by interpolation. Thus the fraction of an inch to be added to 38 to give the required height is obtained by dividing 16.4 (*i.e.*, $42.4-26$) by 42 (*i.e.*, the number of observations between 38 and 39 inches). This fraction is 0.39, and, therefore, 38.39 inches is the height below which five per cent. and above which ninety-five per cent. of the observations fall; *i.e.*, it is the value of the five per cent. grade.

In this way tables 1 to 12 have been calculated from tables 4 to 15 inclusive of the original article. These tables show the heights and weights of Boston school children of both sexes and various ages at percentile grades varying from five per cent. to ninety-five per cent. Separate tables are, moreover, given for children of American parentage, Irish parentage, and for the whole number of observations irrespective of nationality. The values are given in both the English and the metric system of weights and measures, and in the last column of each table are to be found the average heights and weights of children of each age as given in the original article.

The conclusions which may be drawn from a study of these tables will be best understood after an examination of the curves which have been constructed from them, and as a preliminary to this study it will be well to consider briefly the general character of curves representing values at various percentile grades.

TABLES SHOWING HEIGHTS AND WEIGHTS, AMERICAN, IRISH AND TOTAL, AT PERCENTILE GRADES.

TABLE No. 1. — CALCULATED FROM TABLE 4 OF ORIGINAL ARTICLE.

Heights of Boston School-boys irrespective of Nationality.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five,	848	inch,	38.39	39.21	40.15	40.72	41.23	41.67	42.15	42.72	43.36	44.15	44.83	41.57
		c. m.,	97.5	99.6	102.0	103.4	104.7	105.8	107.1	108.6	110.1	112.1	113.9	105.6
Six,	1,258	inch,	40.66	41.43	42.31	42.89	43.39	43.87	44.37	44.86	45.54	46.49	47.13	43.75
		c. m.,	103.3	105.2	107.4	108.9	110.2	111.4	112.7	113.9	115.7	118.1	119.7	111.1
Seven,	1,419	inch,	42.48	43.27	44.20	44.76	45.31	45.83	46.36	46.88	47.55	48.48	49.27	45.74
		c. m.,	107.9	109.9	112.3	113.7	115.1	116.4	117.8	119.1	120.8	123.1	125.1	126.2
Eight,	1,481	inch,	44.46	45.24	46.15	46.81	47.35	47.84	48.36	48.90	49.61	50.58	51.42	47.76
		c. m.,	112.9	114.9	117.2	118.9	120.3	121.5	122.8	124.2	126.0	128.5	130.6	121.3
Nine,	1,437	inch,	46.41	47.18	48.04	48.70	49.27	49.77	50.30	50.87	51.60	52.61	53.46	49.69
		c. m.,	117.9	119.8	122.0	123.7	125.1	126.4	127.8	129.2	131.1	133.6	135.8	126.2
Ten,	1,363	inch,	48.11	48.98	49.77	50.45	51.10	51.73	52.34	52.94	53.76	54.85	55.83	51.68
		c. m.,	122.2	124.4	126.4	128.1	129.8	131.4	132.9	134.5	136.6	139.3	141.8	131.3
Eleven,	1,293	inch,	49.47	50.32	51.30	52.08	52.75	53.40	54.04	54.73	55.50	56.54	57.50	53.33
		c. m.,	125.7	127.8	130.3	132.3	134.0	135.6	137.3	139.0	141.0	143.6	146.0	135.4
Twelve,	1,253	inch,	51.10	51.96	53.07	53.78	54.46	55.11	55.75	56.46	57.36	58.75	59.88	55.11
		c. m.,	129.8	132.0	134.8	136.6	138.3	140.0	141.6	143.4	145.7	149.2	152.1	140.0
Thirteen,	1,160	inch,	52.62	53.58	54.81	55.69	56.37	56.98	57.84	58.75	59.80	61.47	62.73	57.21
		c. m.,	133.7	136.1	139.2	141.5	143.2	144.7	146.9	149.2	151.9	156.1	159.3	145.3
Fourteen,	908	inch,	54.57	55.66	57.13	58.07	58.78	59.60	60.48	61.51	62.80	64.61	65.89	59.88
		c. m.,	138.6	141.4	145.1	147.5	149.3	151.4	153.6	156.2	159.5	164.1	167.4	152.1
Fifteen,	636	inch,	56.55	58.07	59.46	60.39	61.33	62.37	63.35	64.41	65.48	66.85	67.90	62.30
		c. m.,	143.6	147.5	151.0	153.4	155.8	158.4	160.9	163.6	166.3	169.8	172.5	158.2
Sixteen,	359	inch,	59.76	61.21	62.80	63.75	64.58	65.35	66.06	66.74	67.47	68.65	69.86	65.00
		c. m.,	151.8	155.5	159.5	161.9	164.0	166.0	167.8	169.5	171.4	174.4	177.4	165.1
Seventeen,	192	inch,	61.40	62.60	63.85	64.98	65.57	66.21	67.01	67.97	68.74	69.98	70.94	66.16
		c. m.,	156.0	159.0	162.2	165.0	166.5	168.2	170.2	172.6	174.6	177.4	180.2	168.0
Eighteen,	84	inch,	63.04	63.88	64.87	65.55	66.19	66.79	67.39	67.99	68.75	70.10	70.80	66.66
		c. m.,	160.1	162.3	164.8	166.5	168.1	169.6	171.2	172.7	174.6	178.1	179.8	169.3

TABLE No. 2. — CALCULATED FROM TABLE 5 OF ORIGINAL ARTICLE.

Heights of Boston School-boys of American Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	201	inch,	38.22	39.26	40.34	40.95	41.40	41.84	42.34	42.88	43.54	44.38	44.94	41.74
		c. m.,	97.08	99.72	102.46	104.01	105.16	106.27	107.54	108.91	110.59	112.72	114.15	106.0
Six, ...	342	inch,	41.09	41.83	42.56	43.14	43.57	44.00	44.57	45.17	45.87	46.79	47.62	44.10
		c. m.,	104.37	106.25	108.10	109.58	110.67	111.76	113.21	114.73	116.51	118.85	120.95	112.0
Seven, ...	369	inch,	42.79	43.83	44.65	45.44	45.84	46.36	46.87	47.41	47.96	48.92	49.70	46 21
		c. m.,	108.69	111.33	113.41	115.42	116.44	117.76	119.06	120.43	121.83	124.27	126.25	117.4
Eight, ...	407	inch,	44.57	45.45	46.43	47.18	47.78	48.34	48.88	49.46	50.06	50.98	51.93	48.16
		c. m.,	113.21	115.44	117.93	119.83	121.36	122.78	124.15	125.62	127.15	129.49	131.91	122.3
Nine, ...	381	inch,	46.92	47.44	48.30	49.04	49.55	50.07	50.64	51.25	51.96	53.09	54.00	50.09
		c. m.,	119.18	120.50	122.68	124.56	125.86	127.18	128.62	130.17	131.98	134.85	137.16	127.2
Ten, ...	360	inch,	48.91	49.39	50.20	51.02	51.65	52.24	52.76	53.44	54.32	55.50	56.33	52.21
		c. m.,	124.24	125.45	127.51	129.59	131.19	132.69	134.01	135.74	137.97	140.97	143.08	132.6
Eleven, ...	350	inch,	50.06	50.76	52.02	52.68	53.39	54.14	54.86	55.62	56.37	57.26	58.29	54.01
		c. m.,	127.15	128.93	132.13	133.80	135.61	137.51	139.34	141.27	143.18	145.44	148.06	137.2
Twelve, ...	373	inch,	51.48	52.35	53.54	54.36	55.07	55.68	56.37	57.25	58.43	59.68	60.71	55.78
		c. m.,	130.76	132.97	135.99	138.07	139.88	141.43	143.18	145.41	148.41	151.59	154.20	141.7
Thirteen, ...	391	inch,	53.32	54.23	55.69	56.52	57.26	58.14	58.95	59.80	60.93	62.38	63.65	58.17
		c. m.,	135.43	137.74	141.45	143.56	145.44	147.68	149.73	151.89	154.76	158.45	161.67	147.7
Fourteen, ...	386	inch,	54.44	56.44	58.11	58.89	59.80	60.77	61.87	62.98	64.18	65.62	67.31	61.08
		c. m.,	138.28	142.85	147.60	149.07	151.89	154.36	157.15	159.97	163.02	166.67	170.97	155.1
Fifteen, ...	342	inch.	57.02	58.80	60.08	61.22	62.33	63.17	64.14	65.04	65.96	67.41	68.42	62.96
		c. m.,	144.83	149.45	152.60	155.50	158.32	160.45	162.92	165.20	167.54	171.22	173.79	159.9
Sixteen, ...	232	inch,	60.80	61.93	63.27	64.34	65.23	66.03	66.62	67.22	67.83	69.16	70.22	65.58
		c. m.,	154.43	157.30	160.71	163.42	165.68	167.72	169.21	170.74	172.29	175.67	178.36	166.5
Seventeen, ...	128	inch,	61.70	62.64	64.20	65.11	65.72	66.39	67.14	68.08	68.76	70.03	70.94	66.29
		c. m.,	156.72	159.11	163.07	165.35	166.93	168.63	170.54	172.92	174.65	178.00	180.19	168.4
Eighteen, ...	65	inch,	63.07	64.08	65.08	65.62	66.18	66.77	67.36	67.95	68.86	70.42	70.95	66.76
		c. m.,	160.20	162.76	165.30	166.67	168.10	169.60	171.09	172.59	174.90	178.87	180.21	169.5

TABLE NO. 3. — CALCULATED FROM TABLE 6 OF ORIGINAL ARTICLE.

Heights of Boston School-boys of Irish Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five,	366	inch,	38.66	39.31	40.13	40.70	41.23	41.70	42.21	42.77	43.41	44.17	44.76	41.59
		c. m.,	98.2	99.8	101.9	103.4	104.7	105.9	107.2	108.6	110.3	112.2	113.7	105.5
Six,	503	inch,	40.58	41.41	42.31	42.88	43.40	43.90	44.33	44.74	45.30	46.22	47.05	43.74
		c. m.,	103.1	105.2	107.5	108.9	110.2	111.5	112.6	113.6	115.1	117.4	119.5	111.1
Seven,	562	inch,	42.47	43.22	44.08	44.63	45.17	45.68	46.19	46.67	47.27	48.15	49.09	45.61
		c. m.,	107.9	109.8	112.0	113.4	114.7	116.0	117.3	118.5	120.1	122.3	124.7	115.8
Eight,	588	inch,	44.77	45.38	46.24	46.88	47.36	47.80	48.26	48.73	49.38	50.37	51.09	47.72
		c. m.,	113.7	115.3	117.4	119.1	120.3	121.4	122.6	123.8	125.4	127.9	129.8	121.2
Nine,	556	inch,	46.51	47.18	48.03	48.60	49.14	49.61	50.11	50.72	51.48	52.46	53.12	49.53
		c. m.,	118.1	119.8	122.0	123.4	124.8	126.0	127.3	128.8	130.8	133.2	134.9	125.2
Ten,	571	inch,	47.93	48.93	49.75	50.40	50.99	51.62	52.22	52.77	53.56	54.66	55.73	51.57
		c. m.,	121.7	124.3	126.4	128.0	129.5	131.1	132.6	134.0	136.0	138.8	141.5	131.1
Eleven,	548	inch,	49.41	50.34	51.29	51.98	52.58	53.17	53.76	54.42	55.16	56.01	56.95	53.10
		c. m.,	125.5	127.9	130.3	132.0	133.6	135.0	136.5	138.2	140.1	142.3	144.6	134.9
Twelve,	497	inch,	51.02	51.76	52.80	53.58	54.27	54.89	55.51	56.14	56.85	58.08	59.57	54.82
		c. m.,	129.6	131.5	134.1	136.1	137.8	139.4	141.0	142.6	144.4	147.5	151.3	139.3
Thirteen,	463	inch,	52.54	53.45	54.59	55.36	55.99	56.58	57.26	58.17	59.06	60.37	61.74	56.70
		c. m.,	133.4	135.8	138.7	140.6	142.2	143.7	145.4	147.7	150.0	153.3	156.8	144.0
Fourteen,	334	inch,	54.44	55.52	56.89	57.62	58.25	58.81	59.56	60.38	61.31	62.73	63.94	58.88
		c. m.,	138.3	141.0	144.5	146.3	147.9	149.4	151.3	153.4	155.7	159.3	162.4	149.5
Fifteen,	155	inch,	56.24	57.28	58.75	59.62	60.33	60.98	61.83	62.96	64.00	65.37	66.07	61.15
		c. m.,	142.8	145.5	149.2	151.4	153.2	154.9	157.0	159.9	162.6	166.0	167.8	155.3
Sixteen,	61	inch,	58.50	59.35	61.40	63.19	63.70	64.42	65.29	65.97	66.83	67.70	68.45	64.09
		c. m.,	148.6	150.7	156.0	160.5	161.8	163.6	165.8	167.6	169.7	172.0	173.9	162.8
Seventeen,	26	inch,	60.50	63.10	63.64	65.06	65.68	66.75	67.52	68.17	68.95	69.97	70.70	66.20
Eighteen,	5	c. m.,	153.7	160.3	161.6	165.2	166.8	169.5	171.4	173.1	175.1	177.2	179.6	168.2

TABLE NO. 4. — CALCULATED FROM TABLE 7 OF ORIGINAL ARTICLE.

Weights of Boston School-boys irrespective of Nationality.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	848	pound,	34.36	35.36	37.36	38.75	39.85	40.96	42.08	43.54	45.01	47.31	49.35	41.09
		kilogram,	15.59	16.05	16.96	17.58	18.07	18.59	19.10	19.76	20.42	21.47	22.39	18.64
Six, ...	1,258	pound,	38.01	39.06	41.07	42.64	43.83	45.02	46.27	47.75	49.24	51.75	53.55	45.17
		kilogram,	17.24	17.72	18.63	19.35	19.89	20.43	20.99	21.67	22.34	23.47	24.29	20.49
Seven, ...	1,419	pound,	40.55	42.54	44.49	46.30	47.60	48.90	50.27	51.97	53.67	56.68	59.00	49.07
		kilogram,	18.40	19.30	20.18	21.01	21.60	22.19	22.80	23.57	24.34	25.71	26.76	22.26
Eight, ...	1,481	pound,	44.37	46.59	48.95	50.78	52.17	53.57	55.23	57.01	59.25	62.15	64.94	53.92
		kilogram,	20.13	21.14	22.21	23.03	23.67	24.30	25.05	25.86	26.87	28.20	29.46	24.46
Nine, ...	1,437	pound,	48.89	50.97	53.74	55.55	57.26	58.95	60.62	62.41	64.70	68.06	70.95	59.23
		kilogram,	22.18	23.12	24.38	25.20	25.98	26.74	27.50	28.32	29.35	30.88	32.19	26.87
Ten, ...	1,363	pound,	52.59	55.07	58.47	60.87	63.10	65.18	67.23	69.24	72.05	75.98	79.13	65.30
		kilogram,	23.86	24.98	26.52	27.61	28.63	29.57	30.50	31.41	32.68	34.47	35.90	29.62
Eleven, ...	1,293	pound,	56.60	59.45	63.09	65.66	67.74	69.74	71.92	74.16	77.12	81.63	85.95	70.18
		kilogram,	25.67	26.36	28.62	29.79	30.74	31.64	32.63	33.64	34.99	37.04	39.00	31.84
Twelve, ...	1,253	pound,	61.40	64.29	68.29	71.17	73.46	75.74	78.05	81.24	84.96	91.10	96.66	76.92
		kilogram,	27.85	29.16	30.98	32.29	33.33	34.37	35.41	36.86	38.55	41.33	43.85	34.89
Thirteen, ...	1,160	pound,	67.23	70.75	74.53	77.47	80.15	82.90	85.97	89.51	94.47	102.39	108.80	84.84
		kilogram,	30.50	32.10	33.81	35.15	36.37	37.62	39.01	40.61	42.85	46.46	49.36	38.49
Fourteen, ...	908	pound,	72.16	76.38	81.92	85.72	89.47	93.03	96.86	101.74	107.40	116.99	124.83	94.91
		kilogram,	32.74	34.65	37.17	38.90	40.59	42.20	43.94	46.16	48.73	53.07	56.63	42.95
Fifteen, ...	636	pound,	80.70	85.41	91.78	97.05	101.74	106.00	110.72	115.38	121.76	131.08	139.40	107.10
		kilogram,	36.62	38.76	41.63	44.03	46.16	48.09	50.23	52.34	55.23	59.47	63.24	48.59
Sixteen, ...	359	pound,	92.95	98.30	108.40	112.89	116.77	121.38	124.51	128.23	133.70	142.03	148.00	121.01
		kilogram,	42.17	44.60	49.18	51.22	52.98	55.06	56.48	58.17	60.66	64.44	67.15	54.90
Seventeen, ...	192	pound,	101.20	109.20	114.76	118.84	122.38	126.57	131.80	136.77	140.78	150.40	156.40	127.49
		kilogram,	45.91	49.54	52.06	53.92	55.52	57.42	59.79	62.05	63.87	68.23	70.95	57.84
Eighteen, ...	84	pound,	106.80	115.92	121.87	124.98	128.04	131.71	135.47	138.36	142.01	147.20	157.20	132.55
		kilogram,	48.45	52.60	55.28	56.69	58.09	59.75	61.46	62.77	64.43	66.79	71.32	60.13

TABLE No. 5. — CALCULATED FROM TABLE 8 OF ORIGINAL ARTICLE.

Weights of Boston School-boys of American Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	201	pound,	34.19	35.13	37.00	38.54	39.70	40.87	42.05	43.59	45.14	47.87	49.98	41.20
		kilogram,	15.51	15.94	16.79	17.48	18.01	18.54	19.08	19.78	20.48	21.72	22.67	18.71
Six, ...	342	pound,	38.01	38.98	40.94	42.55	43.76	44.97	46.24	47.85	49.46	52.40	54.54	45.14
		kilogram,	17.24	17.68	18.58	19.31	19.85	20.40	20.98	21.72	22.44	23.77	24.73	20.48
Seven, ...	369	pound,	40.37	42.45	44.56	46.46	47.92	49.39	50.91	52.48	54.10	57.24	59.81	49.47
		kilogram,	18.32	19.26	20.21	21.08	21.75	22.41	23.09	23.81	24.54	25.97	27.13	22.44
Eight, ...	407	pound,	45.26	47.00	49.43	51.13	52.61	54.10	55.76	57.42	59.77	62.83	65.15	54.43
		kilogram,	20.54	21.33	22.43	23.19	23.87	24.54	25.29	26.05	27.11	28.51	29.56	24.70
Nine, ...	381	pound,	48.80	51.07	54.11	55.94	57.78	59.41	61.01	62.87	65.11	69.82	73.41	59.97
		kilogram,	22.14	23.16	24.54	25.38	26.21	26.95	27.67	28.52	29.54	31.67	33.31	26.58
Ten, ...	360	pound,	54.00	56.25	59.61	62.64	64.56	66.46	68.31	70.24	73.12	76.86	80.29	66.62
		kilogram,	24.49	25.51	27.04	28.42	29.28	30.15	30.99	31.87	33.17	34.87	36.43	30.22
Eleven, ...	350	pound,	58.35	62.18	65.36	67.51	69.41	71.52	73.75	76.14	79.45	84.90	89.17	72.39
		kilogram,	26.47	28.21	29.65	30.63	31.49	32.45	33.46	34.54	36.04	38.52	40.46	32.83
Twelve, ...	373	pound,	62.38	65.16	69.95	72.64	75.32	78.04	81.22	84.34	88.90	95.62	102.24	79.82
		kilogram,	28.30	29.56	31.73	32.96	34.18	35.41	36.85	38.26	40.34	43.38	46.39	36.21
Thirteen, ...	391	pound,	69.80	72.94	76.93	79.79	82.45	85.71	89.16	93.83	99.78	107.58	114.23	88.26
		kilogram,	31.66	33.10	34.90	36.20	37.41	38.89	40.45	42.57	45.26	48.81	51.82	40.04
Fourteen, ...	386	pound,	74.91	78.74	84.14	89.04	93.22	97.44	101.73	106.83	114.17	124.16	131.85	99.28
		kilogram,	33.98	35.73	38.17	40.40	42.29	44.21	46.15	48.47	51.80	56.32	59.82	45.03
Fifteen, ...	342	pound,	81.24	87.20	95.35	101.50	105.85	110.84	114.58	119.57	126.76	135.93	141.96	110.84
		kilogram,	36.86	39.57	43.26	46.05	48.03	50.29	51.98	54.25	57.50	61.67	64.41	50.26
Sixteen, ...	232	pound,	96.30	101.28	110.08	114.84	119.29	123.33	126.23	130.76	136.65	145.02	151.60	123.67
		kilogram,	43.69	45.95	49.95	52.10	54.12	55.95	57.26	59.32	61.99	65.80	68.77	56.09
Seventeen, ...	128	pound,	98.80	110.36	115.53	119.54	123.29	127.60	133.40	137.57	140.85	150.13	154.60	128.72
		kilogram,	44.82	50.07	52.42	54.23	55.93	57.89	60.52	62.42	63.91	68.11	70.13	58.40
Eighteen, ...	65	pound,	114.16	116.80	122.00	125.25	128.00	131.20	135.20	137.80	142.00	152.00	160.80	132.71
		kilogram,	51.79	52.99	55.35	56.72	58.07	59.52	61.34	62.52	64.43	68.96	72.96	60.20

TABLE No. 6. — CALCULATED FROM TABLE 9 OF ORIGINAL ARTICLE.

Weights of Boston School-boys of Irish Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	366	pound,	34.66	35.72	37.83	39.04	40.17	41.29	42.51	43.89	45.28	47.70	49.48	41.33
		kilogram,	15.72	16.21	17.17	17.71	18.23	18.73	19.29	19.91	20.55	21.65	22.45	18.75
Six, ...	503	pound,	38.05	39.16	41.40	42.86	44.03	45.20	46.41	47.69	48.98	51.00	53.33	45.25
		kilogram,	17.26	17.76	18.78	19.45	19.97	20.51	21.06	21.64	22.22	23.13	24.19	20.52
Seven, ...	562	pound,	41.24	42.77	44.70	46.40	47.61	48.82	50.04	51.71	53.39	56.17	57.87	48.90
		kilogram,	18.71	19.41	20.28	21.05	21.61	22.15	22.70	23.45	24.22	25.48	26.25	22.19
Eight, ...	588	pound,	45.32	47.08	49.63	51.13	52.45	53.78	55.42	57.14	59.29	61.88	64.73	54.12
		kilogram,	20.57	21.37	22.52	23.19	23.79	24.39	25.14	25.92	26.89	28.07	29.36	24.55
Nine, ...	556	pound,	48.55	50.79	53.44	55.38	57.13	58.87	60.61	62.43	64.54	67.55	70.04	58.92
		kilogram,	22.03	23.04	24.24	25.12	25.92	26.70	27.50	28.33	29.27	30.65	31.78	26.73
Ten, ...	571	pound,	52.41	54.83	57.96	60.42	62.78	64.95	67.07	69.12	71.80	75.47	77.95	64.99
		kilogram,	23.78	24.87	26.30	27.41	28.48	29.46	30.43	31.35	32.57	34.24	35.37	29.48
Eleven, ...	548	pound,	56.37	59.32	62.84	65.08	67.25	69.38	71.55	73.74	76.62	80.54	84.65	69.60
		kilogram,	25.57	26.91	28.51	29.53	30.51	31.47	32.46	33.46	34.76	36.54	38.40	31.56
Twelve, ...	497	pound,	60.07	63.91	67.90	70.70	72.95	75.18	77.39	80.02	83.33	89.01	93.45	75.70
		kilogram,	27.25	28.99	30.71	32.08	33.10	34.11	35.12	36.31	37.81	40.38	42.39	34.34
Thirteen, ...	463	pound,	66.66	70.16	73.47	76.19	78.85	81.61	84.65	87.80	91.69	98.70	102.36	82.84
		kilogram,	30.24	31.83	33.33	34.57	35.78	37.03	38.40	39.84	41.59	44.78	46.44	37.58
Fourteen, ...	334	pound,	71.41	74.88	80.54	84.02	87.03	90.28	93.39	97.25	102.20	108.49	115.53	91.19
		kilogram,	32.40	33.97	36.54	38.12	39.49	40.96	42.37	44.12	46.37	49.22	52.42	41.36
Fifteen, ...	155	pound,	80.69	84.44	89.00	92.30	95.65	99.69	104.29	108.71	114.00	121.25	125.10	101.21
		kilogram,	36.61	38.31	40.38	41.88	43.39	45.22	47.31	49.32	51.72	55.00	56.76	45.90
Sixteen, ...	61	pound,	84.00	91.47	97.36	109.07	112.40	115.43	119.28	123.80	128.24	133.12	137.80	112.88
		kilogram,	38.11	41.49	44.17	49.48	51.00	52.38	54.12	56.16	58.18	60.39	62.52	51.19
Seventeen, ... Eighteen, ...	26 5	pound,	102.67	104.80	111.20	115.20	121.20	129.33	132.60	137.40	142.80	145.90	159.60	127.40
		kilogram,	46.58	47.54	50.45	52.27	54.98	58.67	60.16	62.34	64.79	66.20	72.41	57.80

TABLE No. 7. — CALCULATED FROM TABLE 10 OF ORIGINAL ARTICLE.

Heights of Boston School-girls irrespective of Nationality.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five,	605	inch,	38.27	39.08	39.90	40.45	40.95	41.43	41.90	42.41	42.94	43.74	44.58	41.29
		c. m.,	97.2	99.3	101.3	102.7	104.0	105.2	106.4	107.7	110.1	111.1	113.2	104.9
Six,	987	inch,	40.30	41.10	41.91	42.45	42.95	43.40	43.85	44.41	45.03	45.90	46.71	43.35
		c. m.,	102.4	104.4	106.5	107.8	109.1	110.2	111.4	112.8	114.4	116.6	118.6	110.1
Seven,	1,199	inch,	42.41	43.12	43.95	44.70	45.14	45.63	46.14	46.73	47.37	48.14	49.05	45.52
		c. m.,	107.7	109.5	111.6	113.5	114.7	115.9	117.2	118.7	120.3	122.3	124.6	115.6
Eight,	1,299	inch,	44.08	44.91	45.94	46.53	47.09	47.65	48.23	48.84	49.56	50.56	51.37	47.58
		c. m.,	112.0	114.1	116.7	118.2	119.6	121.0	122.5	124.1	125.9	128.4	130.5	120.9
Nine,	1,149	inch,	45.81	46.56	47.67	48.41	49.01	49.54	50.08	50.65	51.32	52.33	53.15	49.37
		c. m.,	116.4	118.3	121.1	123.0	124.5	125.8	127.2	128.0	130.4	132.9	135.0	125.4
Ten,	1,089	inch,	47.49	48.37	49.49	50.26	50.88	51.46	52.04	52.65	53.41	54.58	55.66	51.34
		c. m.,	120.6	122.9	125.7	127.7	129.2	130.7	132.2	133.7	135.7	138.6	141.4	130.4
Eleven,	936	inch,	49.33	50.27	51.35	52.14	52.73	53.41	54.16	54.89	55.76	57.05	57.96	53.42
		c. m.,	125.3	127.7	130.4	132.4	133.9	135.7	137.6	139.4	141.6	144.9	147.2	135.7
Twelve,	935	inch,	51.25	52.24	53.45	54.33	55.15	55.88	56.59	57.38	58.39	59.73	60.81	55.88
		c. m.,	130.2	132.7	135.8	138.0	140.1	141.9	143.7	145.7	148.3	151.7	154.5	141.9
Thirteen,	830	inch,	53.61	54.50	55.75	56.80	57.61	58.40	59.19	59.91	60.75	61.79	62.80	58.16
		c. m.,	136.2	138.4	141.6	144.3	146.3	148.3	150.3	152.2	154.3	156.9	159.5	147.7
Fourteen,	675	inch,	55.87	56.98	58.11	58.90	59.59	60.20	60.71	61.28	61.94	62.99	64.05	59.94
		c. m.,	141.9	144.7	147.6	149.6	151.4	152.9	154.2	155.7	157.3	160.0	162.7	152.3
Fifteen,	459	inch,	57.39	58.29	59.33	60.10	60.67	61.21	61.73	62.32	63.15	64.15	65.00	61.10
		c. m.,	145.8	148.1	150.7	152.7	154.1	155.5	156.8	158.3	160.4	162.9	165.1	155.2
Sixteen,	353	inch,	57.82	58.64	59.72	60.49	61.16	61.78	62.37	62.95	63.68	64.77	65.59	61.59
		c. m.,	146.9	148.9	151.7	153.6	155.3	156.9	158.4	159.9	161.7	164.5	166.6	156.4
Seventeen,	233	inch,	58.22	59.08	59.95	60.88	61.58	62.18	62.68	63.21	63.83	64.88	65.85	61.92
		c. m.,	147.9	150.1	152.3	154.6	156.4	157.9	159.2	160.6	162.1	164.8	167.3	157.2
Eighteen,	155	inch,	58.67	59.31	60.12	60.77	61.33	61.85	62.39	62.95	64.14	64.88	65.87	61.95
		c. m.,	149.0	150.6	152.7	154.4	155.8	157.1	158.5	159.9	162.9	164.8	167.3	157.3

TABLE No. 8. — CALCULATED FROM TABLE 11 OF ORIGINAL ARTICLE.

Heights of Boston School-girls of American Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	127	inch,	38.55	39.28	40.14	40.67	41.17	41.60	42.06	42.66	43.31	44.04	44.94	41.47
		c. m.,	97.9	99.8	102.0	103.3	104.6	105.7	106.8	108.4	110.3	111.9	114.2	105.3
Six, ...	236	inch,	40.57	41.27	42.13	42.62	43.11	43.59	44.10	44.75	45.43	46.39	47.36	43.66
		c. m.,	103.1	104.8	107.0	108.3	109.5	110.7	112.0	113.7	115.4	117.8	120.3	110.9
Seven, ...	346	inch,	42.71	43.43	44.35	45.01	45.53	46.05	46.57	47.12	47.78	48.71	49.51	45.94
		c. m.,	108.5	110.3	112.7	114.3	115.7	117.0	118.3	119.7	121.4	123.7	125.8	116.7
Eight, ...	338	inch,	44.33	45.25	46.29	47.01	47.60	48.21	48.86	49.50	50.18	51.05	51.82	48.07
		c. m.,	112.6	114.9	117.6	119.4	120.9	122.4	124.1	125.7	127.5	129.7	131.6	122.1
Nine, ...	323	inch,	46.21	46.89	48.08	48.61	49.16	49.70	50.27	50.86	51.64	52.81	53.69	49.61
		c. m.,	117.4	119.1	122.1	123.5	124.9	126.2	127.7	129.2	131.2	134.1	136.4	126.0
Ten, ...	336	inch,	47.91	48.82	49.87	50.70	51.32	51.90	52.50	53.14	53.93	54.98	56.32	51.78
		c. m.,	121.7	124.0	126.7	128.8	130.3	131.8	133.3	135.0	137.0	139.6	143.0	131.5
Eleven, ...	290	inch,	49.69	50.48	51.52	52.37	53.11	53.92	54.63	55.42	56.36	57.52	58.37	53.79
		c. m.,	126.2	128.2	130.9	133.0	134.9	137.0	138.8	140.8	143.1	146.1	148.3	136.6
Twelve, ...	309	inch,	52.18	53.15	54.10	55.12	55.91	56.61	57.34	58.20	59.31	60.51	61.62	57.16
		c. m.,	132.5	135.0	137.4	140.0	142.0	143.8	145.6	147.8	150.6	153.7	156.5	145.2
Thirteen, ...	307	inch,	54.07	54.88	56.41	57.44	58.25	59.10	59.75	60.46	61.27	62.41	63.35	58.75
		c. m.,	137.3	139.4	143.3	145.9	147.9	150.1	151.8	153.6	155.6	158.5	160.9	149.2
Fourteen, ...	290	inch,	56.69	57.71	58.69	59.40	60.03	60.47	60.91	61.54	62.26	63.27	64.27	60.32
		c. m.,	144.0	146.6	149.1	150.9	152.5	153.6	154.7	156.3	158.1	160.7	163.2	153.2
Fifteen, ...	255	inch,	58.11	58.91	59.75	60.39	60.95	61.43	61.89	62.53	63.30	64.36	65.17	61.39
		c. m.,	147.6	149.6	151.8	153.4	154.8	156.0	157.2	158.8	160.8	163.5	165.5	155.9
Sixteen, ...	238	inch,	57.99	58.66	59.70	60.55	61.31	62.02	62.45	63.08	63.80	64.86	65.65	61.72
		c. m.,	147.3	149.0	151.6	153.8	155.7	157.5	158.6	160.2	162.0	164.7	166.7	156.7
Seventeen, ...	168	inch,	58.17	59.11	60.14	61.06	61.76	62.32	62.82	63.34	63.88	64.88	65.82	61.99
		c. m.,	147.7	150.1	152.8	155.1	156.9	158.3	159.6	160.9	162.3	164.8	167.2	157.4
Eighteen, ...	118	inch,	58.58	59.38	60.33	61.02	61.47	61.92	62.47	63.08	64.24	64.90	65.68	62.01
		c. m.,	148.8	150.8	153.2	155.0	156.1	157.3	158.7	160.2	163.2	164.9	166.8	157.5

TABLE NO. 9. — CALCULATED FROM TABLE 12 OF ORIGINAL ARTICLE.

Heights of Boston School-girls of Irish Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Measurement.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	236	inch,	38.21	39.07	40.06	40.49	40.92	41.34	41.76	42.20	42.68	43.32	43.83	41.18
		c. m.,	97.0	99.2	101.7	102.8	103.9	105.0	106.1	107.2	108.4	110.0	111.3	104.6
Six, ...	395	inch,	40.23	41.08	41.76	42.36	42.92	43.39	43.85	44.42	45.06	45.80	46.48	43.29
		c. m.,	102.2	104.3	106.1	107.6	109.0	110.2	111.4	112.8	114.4	116.3	118.1	109.9
Seven, ...	426	inch,	42.54	43.23	44.00	44.54	45.07	45.52	45.97	46.63	47.29	47.94	48.99	45.45
		c. m.,	108.0	109.8	111.8	113.1	114.5	115.6	116.8	118.4	120.1	121.8	124.4	115.4
Eight, ...	486	inch,	43.86	44.65	45.71	46.37	46.90	47.46	48.03	48.65	49.36	50.31	50.96	47.39
		c. m.,	111.4	113.4	116.1	117.8	119.1	120.5	122.0	123.6	125.4	127.8	129.4	120.4
Nine, ...	416	inch,	45.58	46.43	47.53	48.36	49.10	49.60	50.09	50.59	51.15	52.16	52.90	49.27
		c. m.,	115.8	117.9	120.7	122.8	124.7	126.0	127.2	128.5	129.9	132.5	134.4	125.2
Ten, ...	379	inch,	47.49	48.52	49.68	50.34	50.86	51.37	51.87	52.42	52.97	54.21	55.00	51.20
		c. m.,	120.6	123.2	126.2	127.9	129.2	130.5	131.7	133.1	134.5	137.7	139.7	130.1
Eleven, ...	340	inch,	49.50	50.37	51.35	52.03	52.55	53.08	53.73	54.38	55.03	56.18	57.47	53.13
		c. m.,	125.7	127.9	130.4	132.2	133.5	134.8	136.5	138.1	139.8	142.7	146.0	134.9
Twelve, ...	307	inch,	51.12	51.93	53.19	53.98	54.76	55.49	56.18	56.92	57.84	59.33	60.47	55.41
		c. m.,	129.8	131.9	135.1	137.1	139.1	140.9	142.7	144.6	146.9	150.7	153.6	140.8
Thirteen, ...	278	inch,	53.39	54.37	55.49	56.33	57.05	57.75	58.49	59.30	60.18	61.19	62.02	57.64
		c. m.,	135.6	138.1	140.9	143.1	144.9	146.7	148.6	150.6	152.9	155.4	157.5	146.3
Fourteen, ...	192	inch,	55.66	56.80	57.72	58.47	59.21	60.03	60.56	61.11	61.75	62.74	63.54	59.67
		c. m.,	141.4	144.3	146.6	148.5	150.4	152.5	153.8	155.2	156.8	159.4	161.4	151.5
Fifteen, ...	95	inch,	56.23	57.50	58.70	59.50	60.16	60.66	61.15	61.62	62.29	63.64	64.73	60.47
		c. m.,	142.8	146.0	149.1	151.1	152.8	154.1	155.3	156.5	158.2	161.6	164.4	153.5
Sixteen, ...	49	inch,	57.20	58.90	60.06	60.47	60.88	61.32	61.76	62.26	62.80	64.03	64.83	61.05
		c. m.,	145.3	149.6	152.5	153.6	154.6	155.7	156.9	158.1	159.5	162.6	164.7	155.1
Seventeen, ...	18	inch,	58.20	59.10	59.70	60.60	61.32	61.80	62.35	62.95	64.10	65.60	66.80	62.00
Eighteen, ...	6	c. m.,	147.8	150.1	151.6	153.9	155.7	157.0	158.4	159.9	162.8	166.6	169.7	157.5

TABLE NO. 10.—CALCULATED FROM TABLE 13 OF ORIGINAL ARTICLE.

Weights of Boston School-girls irrespective of Nationality.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	605	pound,	32.45	34.31	35.82	37.34	38.59	39.63	40.67	41.72	43.44	45.43	47.88	39.66
		kilogram,	14.72	15.56	16.25	16.94	17.51	17.98	18.45	18.93	19.71	20.62	21.73	17.99
Six, ...	987	pound,	35.42	37.13	39.04	40.43	41.83	43.11	44.37	45.63	47.56	49.78	52.36	43.28
		kilogram,	16.07	16.85	17.71	18.22	18.98	19.56	20.13	20.71	21.58	22.58	23.75	19.63
Seven, ...	1,199	pound,	39.04	40.64	42.87	44.37	45.88	47.30	48.71	50.19	52.45	55.36	57.56	47.46
		kilogram,	17.71	18.44	19.45	20.13	20.82	21.47	22.10	22.77	23.79	25.11	26.11	27.10
Eight, ...	1,299	pound,	42.61	44.25	46.85	48.33	50.31	51.45	53.45	55.27	57.24	60.32	62.60	52.04
		kilogram,	19.34	20.07	21.26	21.93	22.82	23.33	24.24	25.07	25.97	27.37	28.40	23.44
Nine, ...	1,149	pound,	46.16	48.21	51.16	53.22	55.00	56.62	58.28	60.32	62.57	65.83	69.96	57.07
		kilogram,	20.94	21.88	23.20	24.14	24.95	25.68	26.44	27.37	28.39	29.87	31.74	25.91
Ten, ...	1,089	pound,	50.26	52.19	55.26	57.64	59.56	61.40	63.70	66.24	69.03	73.43	76.89	62.35
		kilogram,	22.80	23.68	25.07	26.15	27.01	27.85	28.90	30.05	31.31	33.32	34.88	28.29
Eleven, ...	936	pound,	54.08	56.16	59.61	62.42	64.92	67.62	70.48	73.36	77.07	83.71	89.27	68.84
		kilogram,	23.90	25.47	27.04	28.32	29.45	30.62	31.98	33.28	34.97	37.98	40.50	31.23
Twelve, ...	935	pound,	59.69	62.97	67.32	70.64	73.53	77.08	80.50	84.04	88.23	94.71	102.73	78.31
		kilogram,	27.07	28.57	30.55	32.05	33.36	34.98	36.53	38.13	40.03	41.21	46.61	35.53
Thirteen, ...	830	pound,	65.75	70.37	75.16	79.33	83.92	88.02	91.98	96.46	102.12	108.47	115.42	88.65
		kilogram,	23.83	31.93	34.10	35.99	38.08	39.94	41.72	43.76	46.33	49.21	52.37	40.21
Fourteen, ...	675	pound,	76.57	80.36	85.76	90.14	94.00	97.75	101.23	105.68	109.94	117.12	124.73	98.43
		kilogram,	34.74	36.46	38.91	40.89	42.64	44.35	45.92	47.95	49.88	53.14	56.58	44.65
Fifteen, ...	459	pound,	83.39	88.80	95.43	99.59	102.49	105.11	108.43	112.39	117.64	124.14	132.22	106.08
		kilogram,	37.84	40.29	43.30	45.18	46.50	47.69	49.20	51.00	53.38	56.31	59.99	48.12
Sixteen, ...	353	pound,	88.47	93.51	99.05	103.50	107.28	111.27	115.79	119.95	124.79	130.99	135.94	112.03
		kilogram,	40.14	42.42	44.93	46.96	48.68	50.48	52.54	54.42	56.61	59.43	61.68	50.81
Seventeen, ...	233	pound,	93.20	97.75	104.32	107.57	110.02	112.76	117.20	122.75	127.54	135.88	141.15	115.53
		kilogram,	42.28	44.35	47.33	48.81	49.92	51.16	53.18	55.69	57.86	61.65	64.04	52.41
Eighteen, ...	155	pound,	95.20	98.40	102.36	105.18	110.16	112.64	116.80	122.88	127.33	133.45	138.80	115.16
		kilogram,	43.19	44.64	46.44	47.72	49.98	51.11	52.99	55.75	57.77	60.54	62.97	52.24

TABLE No. 11. — CALCULATED FROM TABLE 14 OF ORIGINAL ARTICLE.

Weights of Boston School-girls of American Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five,	127	pound,	32.52	34.34	35.92	37.51	38.64	39.56	40.49	41.41	42.97	45.64	50.40	39.82
		kilogram,	14.76	15.57	16.30	17.02	17.53	17.94	18.37	18.79	19.50	20.71	22.86	18.06
Six,	236	pound,	35.69	37.37	39.22	40.72	42.18	43.44	44.70	45.96	48.34	51.48	53.84	43.81
		kilogram,	16.19	16.96	17.79	18.48	19.14	19.71	20.28	20.86	21.93	23.35	24.42	19.87
Seven,	346	pound,	39.43	41.16	43.25	44.90	46.43	47.74	49.04	50.61	52.92	56.23	58.72	48.02
		kilogram,	17.89	18.67	19.62	20.37	21.07	21.67	22.25	22.96	24.01	25.50	26.64	21.78
Eight,	338	pound,	42.85	44.68	47.27	49.26	50.99	52.56	54.15	56.01	57.86	61.47	65.46	52.93
		kilogram,	19.45	20.27	21.45	22.35	23.13	23.84	24.56	25.40	26.25	27.88	29.95	24.01
Nine,	323	pound,	46.60	48.51	51.14	53.01	54.81	56.53	58.38	60.97	63.65	67.34	72.27	57.52
		kilogram,	21.14	22.01	23.19	24.05	24.86	25.74	26.48	27.66	28.87	30.55	32.79	26.10
Ten,	336	pound,	50.36	52.53	55.68	58.18	60.39	62.65	65,10	67.84	71.53	77.37	86.60	64.09
		kilogram,	22.84	23.83	25.26	26.39	27.40	28.42	29.54	30.78	32.45	35.11	39.29	29.07
Eleven,	290	pound,	54.25	56.67	60.05	63.06	65.43	68.75	72.11	75.41	79.40	86.73	92.75	70.26
		kilogram,	24.60	25.70	27.24	28.61	29.69	31.19	32.72	34.22	36.02	39.35	42.08	31.87
Twelve,	309	pound,	62.84	65.79	69.61	72.77	76.48	79.90	83.07	86.62	90.40	97.70	106.10	81.35
		kilogram,	28.51	29.85	31.58	33.02	34.70	36.25	37.69	39.30	41.01	44.33	48.14	36.90
Thirteen,	307	pound,	66.43	71.04	77.66	81.88	86.75	90.88	95.60	100.53	104.38	110.92	116.53	91.18
		kilogram,	30.14	32.23	35.24	37.15	39.36	41.23	43.37	45.61	47.35	50.33	52.87	41.36
Fourteen,	290	pound,	79.29	83.05	88.07	92.14	96.21	99.88	103.52	107.22	110.94	117.76	125.00	100.32
		kilogram,	35.97	37.68	39.96	41.80	43.65	45.31	46.97	48.65	50.34	53.43	56.71	45.50
Fifteen,	255	pound,	86.87	92.14	98.48	102.30	104.52	107.13	110.67	115.05	119.60	125.82	132.80	108.42
		kilogram,	39.41	41.80	44.68	46.42	47.42	48.61	50.21	52.20	54.26	57.08	60.25	49.17
Sixteen,	238	pound,	88.15	93.40	100.03	104.62	108.43	112.80	116.97	120.93	125.66	131.28	136.26	112.97
		kilogram,	40.00	42.37	45.38	47.46	49.20	51.18	53.07	54.86	57.01	59.56	61.82	51.24
Seventeen,	168	pound,	93.52	97.90	104.53	108.16	110.99	113.68	118.70	122.96	127.96	135.83	141.07	115.84
		kilogram,	42.43	44.42	47.42	49.07	50.36	51.58	53.86	55.79	58.06	61.63	64.00	52.54
Eighteen,	118	pound,	95.93	99.02	102.85	105.62	110.71	113.33	117.91	123.72	128.20	133.64	138.40	115.80
		kilogram,	43.52	44.92	46.67	47.92	50.23	51.42	53.50	56.13	58.16	60.63	62.79	52.52

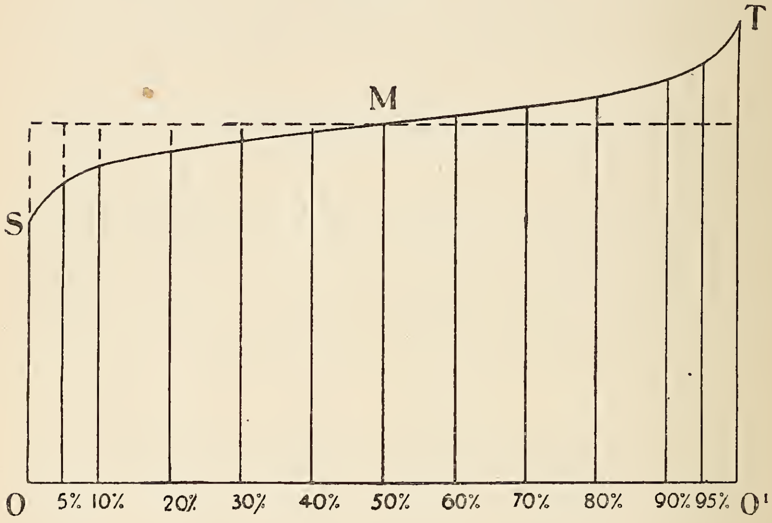
TABLE No. 12.—CALCULATED FROM TABLE 15 OF ORIGINAL ARTICLE.

Weights of Boston School-girls of Irish Parentage.

AGE AT LAST BIRTHDAY.	Number of Observations.	Unit of Weights.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
			5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Five, ...	236	pound,	32.78	34.43	35.95	37.47	38.64	39.61	40.58	41.55	43.14	45.24	47.16	39.63
		kilogram,	14.87	15.62	16.31	17.00	17.53	17.97	18.41	18.85	19.57	20.53	21.40	17.97
Six, ...	395	pound,	35.48	37.24	39.11	40.52	41.93	43.18	44.42	45.67	47.47	49.47	51.60	43.21
		kilogram,	16.10	16.90	17.74	18.39	19.02	19.59	20.15	20.72	21.54	22.44	23.40	19.60
Seven, ...	426	pound,	39.50	41.36	43.12	44.47	45.82	47.20	48.77	50.39	52.73	55.69	57.54	47.64
		kilogram,	17.92	18.76	19.56	20.17	20.79	21.42	22.13	22.86	23.92	25.26	26.10	21.61
Eight, ...	486	pound,	42.31	43.74	46.43	48.48	50.39	51.94	53.48	55.30	57.26	60.25	62.14	51.80
		kilogram,	19.20	19.85	21.07	22.00	22.86	23.56	24.26	25.09	25.98	27.33	28.19	23.50
Nine, ...	416	pound,	45.96	48.17	51.20	53.25	55.01	56.59	58.20	60.05	61.90	65.43	68.99	56.76
		kilogram,	20.86	21.86	23.22	24.15	24.95	25.67	22.77	27.24	28.08	29.69	31.30	25.75
Ten, ...	379	pound,	50.40	52.35	55.45	57.98	59.67	61.36	63.51	65.95	68.29	71.35	73.87	61.59
		kilogram,	22.86	23.75	25.15	26.30	27.06	27.83	28.81	29.92	30.98	32.37	33.51	27.94
Eleven, ...	340	pound,	54.25	56.37	59.58	62.13	64.36	66.68	69.25	72.18	75.75	80.91	85.66	67.83
		kilogram,	24.60	25.57	27.02	28.19	29.19	30.25	31.41	32.75	34.37	36.71	38.87	30.77
Twelve, ...	307	pound,	59.17	61.63	66.04	69.03	71.98	75.09	78.63	82.33	85.95	92.29	97.85	76.15
		kilogram,	26.84	27.96	29.96	31.31	32.65	34.07	35.68	37.36	39.00	41.87	44.40	34.55
Thirteen, ...	278	pound,	64.18	68.80	73.93	77.22	81.53	85.85	89.83	93.32	97.45	103.89	109.60	85.76
		kilogram,	29.11	31.21	33.54	35.04	36.99	38.96	40.76	42.34	44.21	47.13	49.72	38.91
Fourteen, ...	192	pound,	74.80	79.25	83.05	88.40	92.33	95.90	99.56	103.60	108.26	113.93	122.53	96.36
		kilogram,	33.93	35.95	37.68	40.11	41.89	43.51	45.16	47.00	49.12	51.69	55.59	43.71
Fifteen, ...	95	pound,	77.40	83.25	88.67	93.33	97.56	100.62	103.33	105.87	110.50	117.33	130.40	100.46
		kilogram,	35.12	37.77	40.23	42.34	44.26	45.65	46.88	48.03	50.14	53.24	59.16	45.56
Sixteen, ...	49	pound,	87.60	93.80	97.44	99.88	101.84	105.60	109.52	115.73	120.56	130.20	136.00	108.56
		kilogram,	39.75	42.55	44.21	45.31	46.20	47.91	49.69	52.51	54.69	59.07	61.70	49.24
Seventeen, ... Eighteen, ...	18 6	pound,	98.40	100.80	104.40	106.80	108.40	110.00	111.60	113.20	124.40	144.40	161.20	115.82
		kilogram,	44.64	45.73	47.36	48.45	49.18	49.91	50.63	51.36	56.43	65.51	73.14	52.49

A geometrical construction of a special case will perhaps best serve to place the matter in a clear light. Let us suppose one thousand grown men standing in line arranged according to height. The heads of these men will form a curved line represented in its general form by the curve ST in Fig 1. In this diagram the line SO represents the height of the shortest and the line TO¹ that of the tallest man. The curve ST, representing the heights of the intermediate men, is approximately a straight line in a large part of its course but bends up sharply at the right and down sharply at the left owing to the presence of a few very tall and a few very short men. Mediocrity is the rule and extremes the exception in height as in everything else.

Fig. 1.



If now we divide this row of men into two equal parts and ascertain the height of the five hundredth man in the row (or, more accurately speaking, the height half way between that of the five hundredth and that of the five hundred and first man) we shall have a value below which one half and above which the other half of the observations lie. This value is termed by Galton the value of the fifty percentile grade, or the median value, and is designated by the letter M. In the same way the values at other percentile grades may be determined by dividing the row at points corresponding to various percentages of the total number of observations. The percentile grades indicated in Fig. 1 are those adopted by Galton, and are practically sufficient to indicate the character of the curve. With a very large number of observations it would of course be possible to determine values below five per cent. and above ninety-five per cent., but in anthropometrical investigations with existing data it does not seem wise to go beyond these limits.

It is evident that the value M will tend to approximate to the average value of all the observations and will be identical with it when the curve ST is symmetrically disposed on both sides of M, *i. e.*, when the values at sixty, seventy, eighty, ninety and ninety-five per cent. exceed M by the same amount, respectively, by which the values at forty, thirty, twenty, ten and five per cent. fall short of it. If A represent the average value of all the observations, then the value of M—A will be a measure of the direction and extent of the asymmetry of the curve ST, *for this value will be zero when the curve is symmetrical, positive when the values at the lower percentile grades fall short of M more than those at the higher grades exceed it, and negative when the reverse is the case.*

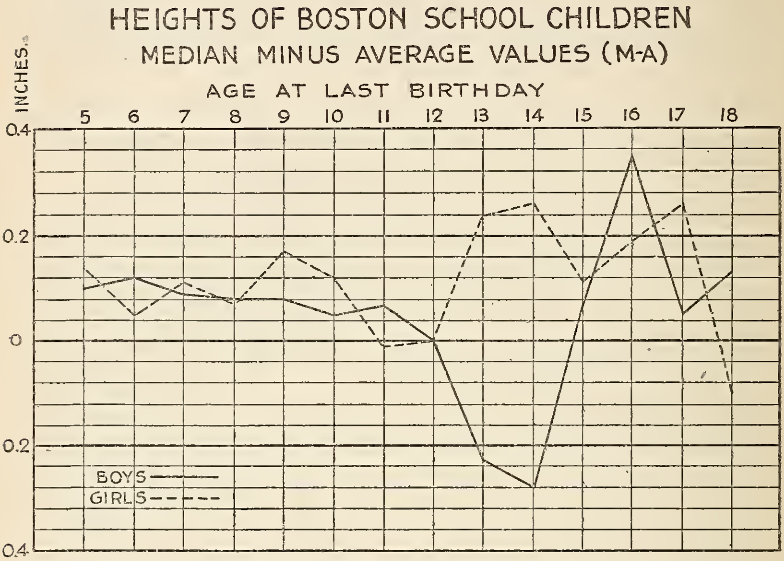
Let us now apply this test to the data in our possession, confining our attention for the present to tables 1, 4, 7 and 10, which give the total number of observations irrespective of nationality. By subtracting the average from the median values in these four tables the following table (No. 12a) has been constructed : —

TABLE 12a. — *Values of M—A.*

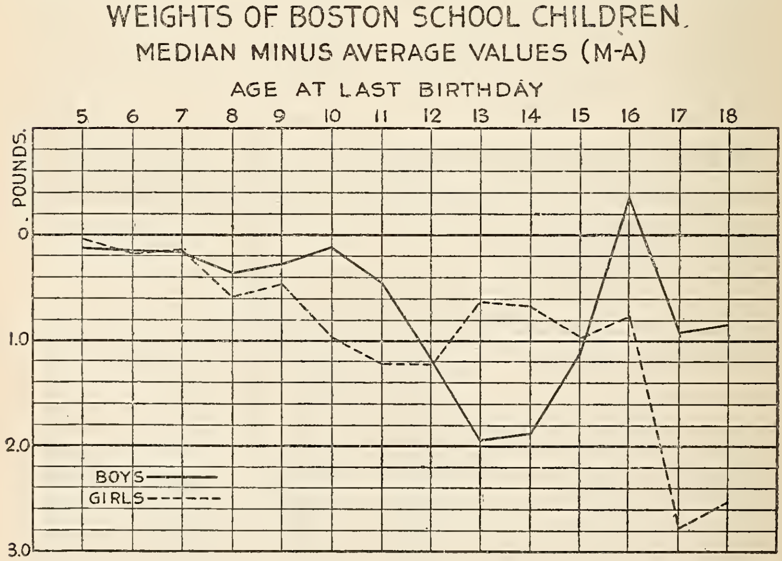
AGE AT LAST BIRTHDAY.	HEIGHTS IN INCHES.		WEIGHTS IN POUNDS.	
	Boys.	Girls.	Boys.	Girls.
Five, ...	+0.10	+0.14	—0.13	—0.03
Six, ...	+0.12	+0.05	—0.15	—0.17
Seven, ...	+0.09	+0.11	—0.17	—0.16
Eight, ...	+0.08	+0.07	—0.35	—0.59
Nine, ...	+0.08	+0.17	—0.28	—0.45
Ten, ...	+0.05	+0.12	—0.12	—0.95
Eleven, ...	+0.07	—0.01	—0.44	—1.22
Twelve, ...	0.00	0.00	—1.18	—1.23
Thirteen, ...	—0.23	+0.24	—1.94	—0.63
Fourteen, ...	—0.28	+0.26	—1.88	—0.68
Fifteen, ...	+0.07	+0.11	—1.10	—0.97
Sixteen, ...	+0.35	+0.19	+0.37	—0.76
Seventeen, ...	+0.05	+0.26	—0.92	—2.77
Eighteen, ...	+0.13	—0.10	—0.84	—2.52

An examination of this table or of the curves constructed from it, as given in Plate 1, shows that the asymmetry of

PLATE I.



HEIGHTS OF BOSTON SCHOOL CHILDREN
MEDIAN MINUS AVERAGE VALUES (M-A)



WEIGHTS OF BOSTON SCHOOL CHILDREN.
MEDIAN MINUS AVERAGE VALUES (M-A)

the curves of percentile grades varies very much, at different ages, both in direction and amount. The variation in the value of M—A in the curves of height is much the same as that in the curves of weight for each sex considered by itself, but there is a great difference between the two sexes. This difference shows itself most distinctly between the ages of eleven and fifteen years. During this time a rise in the curves for the males coincides with a fall in those for the females, while before and after this period the curves, as a rule, rise and fall together. We must conclude, therefore, that the rate of annual increase both in height and weight is different at different percentile grades, or, in other words, that large children grow differently from small ones, and moreover, that between the ages of eleven and fifteen years there is a striking difference in the mode of growth of the two sexes. The significance of this conclusion will be made clearer by an examination of the curves constructed directly from the tables of percentile grades. Curves of this sort are presented in plates 2, 3, 4 and 5, constructed from tables 1, 4, 7 and 10, containing the total number of observations irrespective of nationality. Similar curves have been obtained from the remaining tables in which the observations are grouped according to the nationality of the parents, but as they are less regular, owing to the smaller number of observations from which they are constructed, and lead to no additional conclusions, it has not been thought worth while to present them.

A glance at the curves on plates 2–5 shows at once the nature of the asymmetry, the existence of which is indicated by the curves on Plate 1. It will be observed that during the earlier years of school life the curves for the successive years are fairly symmetrical, which is in harmony with the previous observation that in these years the value of M—A does not differ widely from zero. At about ten years of age in girls and eleven or twelve years in boys, the curves become distinctly asymmetrical, owing to the values increasing more rapidly at the higher than at the lower percentile grades. At the age of twelve or thirteen years in girls and fourteen or fifteen years in boys an asymmetry in the opposite direction shows itself, since at this period the values are increasing

PLATE 2. (FROM TABLE I.)

HEIGHTS OF BOSTON SCHOOLBOYS. IRRESPECTIVE OF NATIONALITY.

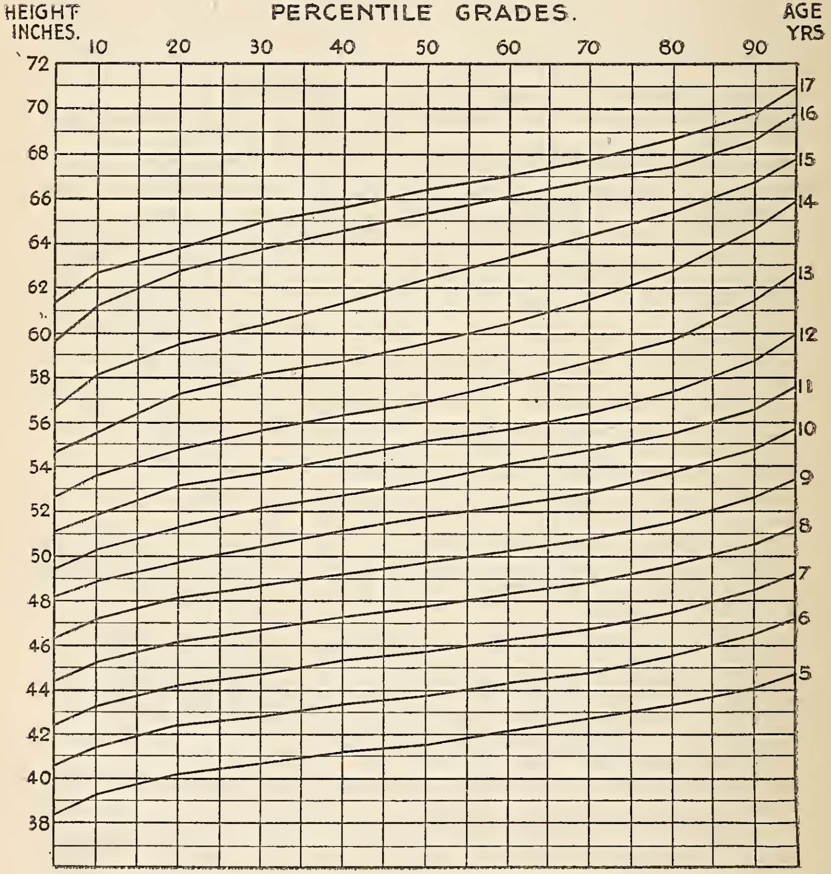


PLATE 3. (FROM TABLE 4.)

WEIGHTS OF BOSTON SCHOOLBOYS.
IRRESPECTIVE OF NATIONALITY.

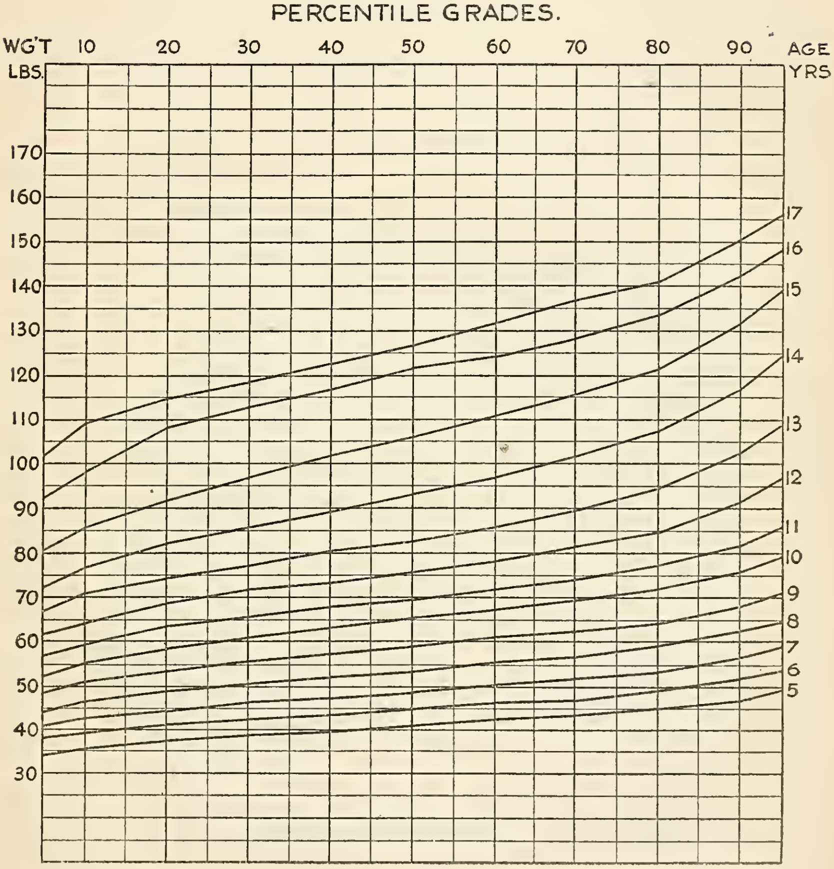


PLATE 4. (FROM TABLE 7)

HEIGHTS OF BOSTON SCHOOLGIRLS.
IRRESPECTIVE OF NATIONALITY.

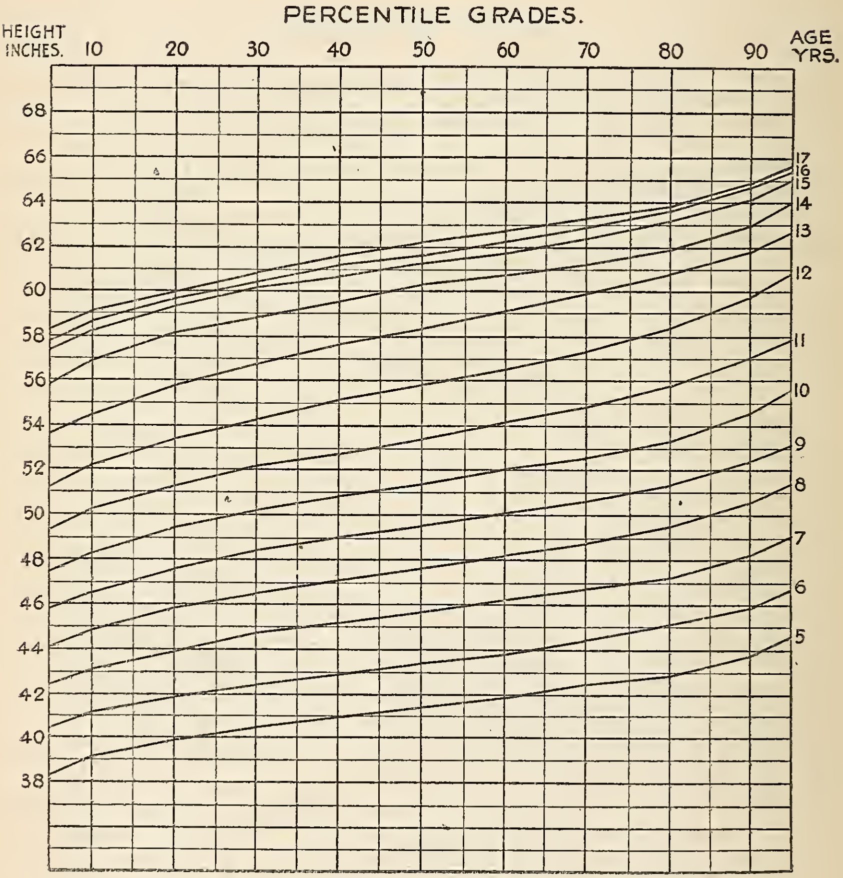
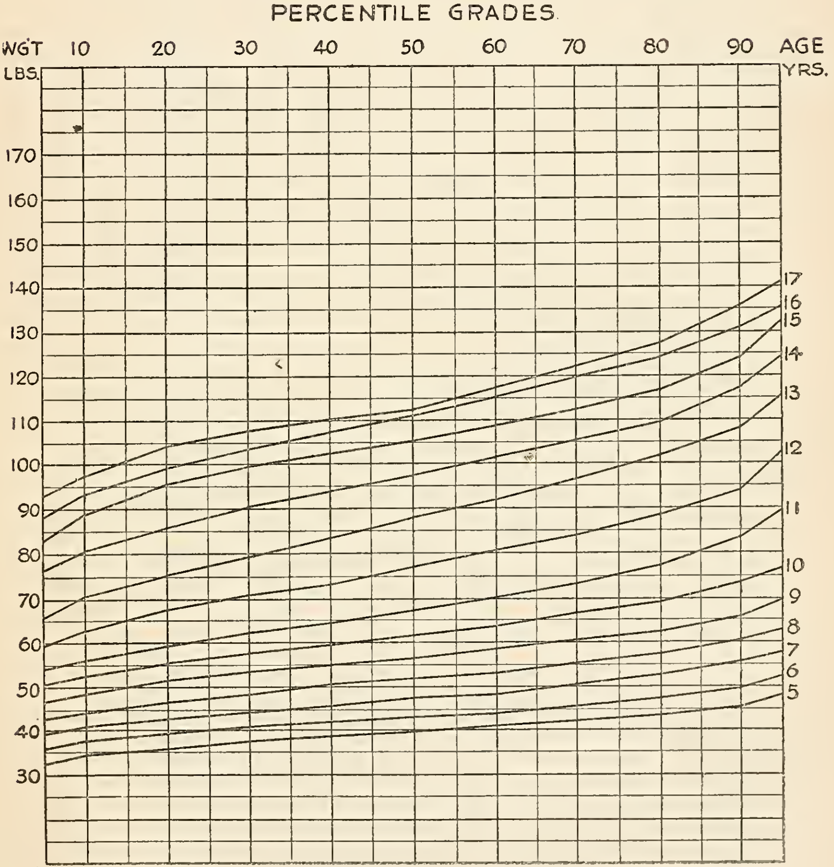


PLATE 5. (FROM TABLE 10.)

WEIGHTS OF BOSTON SCHOOLGIRLS; IRRESPECTIVE OF NATIONALITY.



more rapidly at the lower than at the higher percentile grades. These changes correspond accurately with the fall and rise in the value of M—A, as shown on Plate 1.

In the original article on the growth of children it was shown that about two years before the age of puberty there is a period during which the growth in both height and weight shows a distinct acceleration. Now, the rate of growth at the various percentile grades is represented on plates 2–5 by the vertical distances between the curves corresponding to the successive years; and an inspection of these curves shows that the prepubertal period of accelerated growth, already shown to exist by a comparison of average heights and weights at different ages, occurs all along the line, but that it occurs earlier at the higher than at the lower percentile grades. In other words, we find that the above-mentioned variations in the value of M—A are due to the fact that *the period of acceleration, which is such a distinct phenomenon in the growth of children, occurs at an earlier age in large than in small children.*

The significance of this observation will be best understood by an examination of the annual increase in height and weight of children at the different percentile grades. These values, which are readily obtained from the preceding tables by subtracting the height or weight at any year from that of the year next following, are shown in tables 13, 14, 15 and 16, which have been calculated from tables 1, 4, 7 and 10 respectively.*

---

* It will be noticed that in tables 1, 4, 7 and 10 the ages are given "at the last birthday." Hence the average age of the children thus grouped together will be six months greater than the age given in the tables. For instance, in Table 1, five years six months is the average age of the 848 boys whose heights at various percentile grades are given in the first line. Now since the figures in the tables of annual increase are the differences between the successive heights and weights in tables 1, 4, 7 and 10, it is evident that they express the yearly growth precisely at the age given in the tables. The first line in Table 13, for instance, is the annual growth in height of boys of six years of age.

TABLE 13. — *Showing Annual Growth in Inches of Boston School-boys irrespective of Nationality.*

AGE.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
	5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Six,	2.27	2.22	2.16	2.17	2.16	2.20	2.22	2.14	2.18	2.34	2.30	2.18
Seven,	1.82	1.84	1.89	1.87	1.92	1.96	1.99	2.02	2.01	1.99	2.14	1.99
Eight,	1.98	1.97	1.95	2.05	2.04	2.01	2.00	2.02	2.06	2.10	2.15	2.02
Nine,	1.95	1.94	1.89	1.89	1.92	1.93	1.94	1.97	1.99	2.03	2.04	1.93
Ten,	1.70	1.80	1.73	1.75	1.83	1.96	2.04	2.07	2.16	2.24	2.37	1.99
Eleven,	1.36	1.34	1.53	1.63	1.65	1.67	1.70	1.79	1.74	1.69	1.67	1.65
Twelve,	1.63	1.64	1.77	1.70	1.71	1.71	1.71	1.73	1.86	2.21	2.38	1.78
Thirteen,	1.52	1.62	1.74	1.91	1.91	1.87	2.09	2.29	2.44	2.72	2.85	2.10
Fourteen,	1.95	2.08	2.32	2.38	2.41	2.62	2.64	2.76	3.00	3.14	3.16	2.67
Fifteen,	1.98	2.41	2.33	2.32	2.55	2.77	2.87	2.90	2.68	2.24	2.01	2.42
Sixteen,	3.21	3.14	3.34	3.36	3.25	2.98	2.71	2.33	1.99	1.80	1.96	2.70
Seventeen,	1.64	1.39	1.05	1.23	0.99	0.86	0.95	1.23	1.27	1.33	1.08	1.16

TABLE 14. — *Showing Annual Increase in Pounds of Boston School-boys irrespective of Nationality.*

AGE.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
	5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Six,	3.65	3.70	3.71	3.89	3.98	4.06	4.19	4.21	4.23	4.44	4.20	4.08
Seven,	2.54	3.48	3.42	3.66	3.77	3.88	4.00	4.22	4.43	4.93	5.45	3.90
Eight,	3.82	4.05	4.46	4.48	4.57	4.67	4.96	5.04	5.58	5.47	5.94	4.85
Nine,	4.52	4.38	4.79	4.77	5.09	5.38	5.39	5.40	5.45	5.91	6.01	5.31
Ten,	3.70	4.10	4.73	5.32	5.84	6.23	6.61	6.83	7.35	7.92	8.18	6.07
Eleven,	4.01	4.38	4.62	4.79	4.64	4.56	4.69	4.92	5.07	5.65	6.82	4.88
Twelve,	4.80	4.84	5.20	5.51	5.72	6.00	6.13	7.08	7.84	9.47	10.71	6.74
Thirteen,	5.83	6.46	6.24	6.30	6.69	7.16	7.92	8.27	9.51	11.29	12.14	7.92
Fourteen,	4.93	5.63	7.39	8.25	9.32	10.13	10.89	12.23	12.93	14.60	16.03	10.07
Fifteen,	8.54	9.03	9.86	11.33	12.27	12.97	13.86	13.64	14.36	14.09	14.57	12.19
Sixteen,	12.25	12.89	16.62	15.84	15.03	15.38	13.79	12.85	11.94	10.95	8.60	13.91
Seventeen,	8.25	10.90	6.36	5.95	5.61	5.19	7.29	8.54	7.08	8.37	8.40	6.48

Table 15.— *Showing Annual Growth in Inches of Boston School-girls irrespective of Nationality.*

Age.	Values at the Following Percentile Grades.											Average.
	5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Six,	2.03	2.02	2.01	2.00	2.00	1.97	1.95	2.00	2.09	2.16	2.13	2.06
Seven,	2.11	2.02	2.04	2.25	2.19	2.23	2.29	2.32	2.34	2.24	2.34	2.17
Eight,	1.67	1.79	1.99	1.83	1.95	2.02	2.09	2.11	2.19	2.42	2.32	2.06
Nine,	1.73	1.65	1.73	1.88	1.92	1.89	1.85	1.81	1.76	1.77	1.78	1.79
Ten,	1.68	1.81	1.82	1.85	1.87	1.92	1.96	2.00	2.09	2.25	2.51	1.97
Eleven,	1.84	1.90	1.86	1.88	1.85	1.95	2.12	2.24	2.35	2.47	2.30	2.08
Twelve,	1.92	1.97	2.10	2.19	2.42	2.47	2.43	2.49	2.63	2.68	2.85	2.46
Thirteen,	2.36	2.26	2.30	2.47	2.46	2.52	2.60	2.53	2.36	2.06	1.99	2.28
Fourteen,	2.26	2.48	2.36	2.10	1.98	1.80	1.52	1.37	1.19	1.20	1.25	1.78
Fifteen,	1.52	1.31	1.22	1.20	1.08	1.01	1.02	1.04	1.21	1.16	0.95	1.16
Sixteen,	0.43	0.35	0.39	0.39	0.49	0.57	0.64	0.63	0.53	0.62	0.59	0.49
Seventeen,	0.40	0.44	0.23	0.39	0.42	0.40	0.31	0.26	0.15	0.11	0.26	0.33

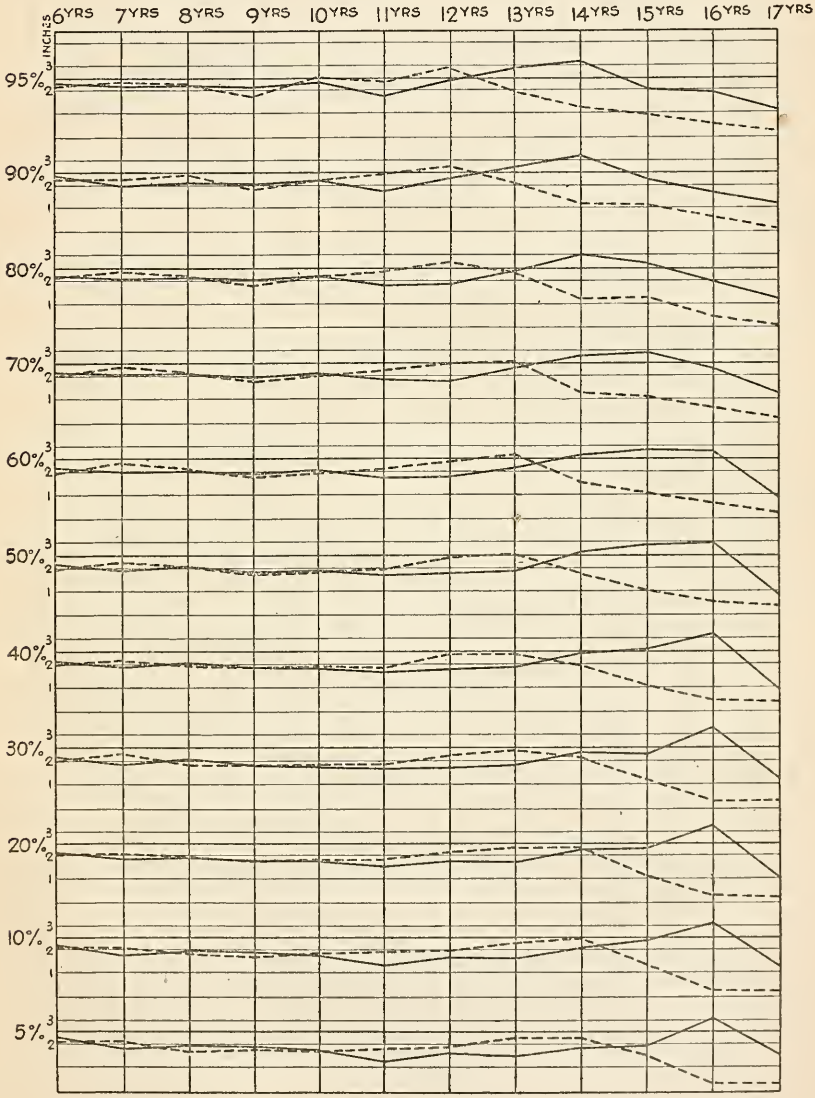
TABLE 16.— *Showing Annual Increase in Pounds of Boston School-girls irrespective of Nationality.*

AGE.	VALUES AT THE FOLLOWING PERCENTILE GRADES.											Average.
	5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.	
Six,	2.97	2.82	3.22	3.09	3.24	3.48	3.70	3.91	4.12	4.35	4.48	3.62
Seven,	3.62	3.51	3.83	3.94	4.05	4.19	4.34	4.56	4.89	5.58	5.20	4.18
Eight,	3.57	3.61	3.98	3.96	4.43	4.15	4.74	5.08	4.79	4.96	5.04	4.58
Nine,	3.55	3.96	4.31	4.89	4.69	5.17	4.83	5.05	5.33	5.51	7.36	5.03
Ten,	4.10	3.98	4.10	4.42	4.56	4.78	5.42	5.92	6.46	7.60	6.93	5.28
Eleven,	3.82	3.97	4.35	4.78	5.36	6.22	6.78	7.12	8.04	10.28	12.38	6.49
Twelve,	5.61	6.81	7.71	8.22	8.61	9.46	10.02	10.68	11.16	11.00	13.46	9.47
Thirteen,	6.06	7.40	7.84	8.69	10.39	10.94	11.48	12.42	13.89	13.76	12.69	10.34
Fourteen,	10.82	9.99	10.60	10.81	10.08	9.73	9.25	9.22	7.82	8.65	9.31	9.78
Fifteen,	6.82	8.44	9.67	9.45	8.49	7.36	7.20	6.71	7.70	7.02	7.49	7.65
Sixteen,	5.08	4.71	3.62	3.91	4.79	6.16	7.36	7.56	7.15	6.85	3.72	5.95
Seventeen,	4.73	4.24	5.27	4.07	2.74	1.49	1.41	2.80	2.75	4.89	5.21	3.50

The conclusions to be drawn from these tables will be most readily understood by an examination of the curves on plates 6 and 7, which have been constructed from them, the curves

PLATE 6. (FROM TABLES 13 & 15.) BOYS ——— GIRLS -----

ANNUAL INCREASE IN INCHES



representing the yearly growth of the two sexes being, for easier comparison, plotted on the same system of co-ordinates.

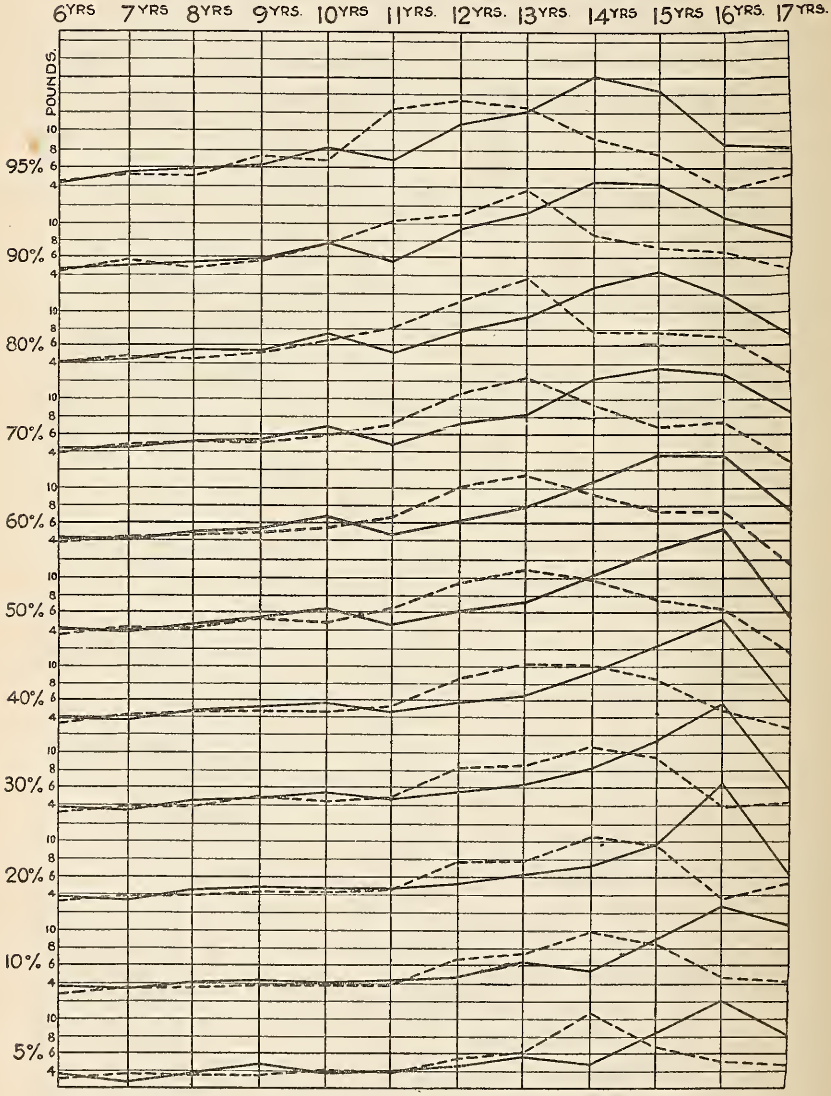


PLATE 7 (FROM TABLES 14 & 16) BOYS——— GIRLS------

ANNUAL INCREASE IN POUNDS.

The following are the most obvious conclusions: —

1. The maximum yearly growth in both height and weight is at all percentile grades greater in boys than in girls, and occurs in boys two or three years later than in girls.

2. The age at which this maximum yearly growth in height and weight is reached is, in both sexes, earlier at the higher than at the lower percentile grades, the range being from twelve to fourteen years for girls and from fourteen to sixteen years for boys. In other words, large children make their most rapid growth at an earlier age than small ones.

3. The curves representing the annual growth of boys are characterized on either side of the maximum by a steeper rise and fall in the lower than in the higher percentile grades, though the maximum itself may be quite as high in the former as in the latter grades. This indicates that the above-mentioned period of accelerated growth in large boys differs from that in small boys rather in duration than in intensity. In girls a difference of this sort does not seem to exist.

4. In boys at eleven years of age there is a period of remarkably slow growth both in height and weight, the curves of annual increase in nearly all the percentile grades reaching at this age a lower point than for several years preceding or subsequent to this age. In girls a similar but less marked period of retarded growth in height is to be noticed at nine years of age, but the rate of growth in weight does not seem to suffer a corresponding diminution.*

One of the conclusions reached in the original article to which reference has been made was that "at about thirteen or fourteen years girls in this community are, during more than two years, both taller and heavier than boys at the same age, though before and after that period the reverse is the case." The dependence of this phenomenon upon the fact that the prepubertal period of accelerated growth occurs earlier in girls than in boys was also pointed out. It will be interesting now to inquire in what way this period of female superiority is affected by the fact that the maximum rate of growth is reached earlier in the higher than in the lower percentile grades. The influence of this circumstance is readily understood from an inspection of the curves on plates 8 and 9, which have been constructed from the figures on plates 1, 4, 7 and 10. Here the absolute heights and weights of boys and girls of the same percentile grade are plotted on the same system of co-ordinates, while the ordinates for the successive percentile grades differ from each other by five inches or twenty-five pounds respectively.

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* It is interesting, however, to notice that in the curves constructed by Dr. Stevenson (See "Lancet," Sept. 22, 1888) from English and American statistics, and representing the annual increase in weight of "boys and girls of the English-speaking races," the period of retarded growth is a marked phenomenon in both sexes, occurring in boys at eleven and in girls at nine years of age.

See also "Axel Key, Die. Pubertätsentwickelung." (Verhandlungen des X internationalen medicinschen Congresses, Berlin, 1890. Bd. 1., p. 67.) This observer finds that in Sweden the period of least increase in height and weight occurs at ten years for boys and nine years for girls.

In this way the curves are brought vertically over one another and a comparison between them is facilitated. The points where the curves of growth of the two sexes intersect each other are joined by dotted lines, in order that the periods of female superiority at the various percentile grades may be readily compared with each other. A glance at the curves suffices to show that the period of female superiority is to be observed at all percentile grades both in height and weight, and, moreover, that it both begins and ends earlier in the higher than in the lower percentile grades. Thus, in the ninety-five percentile grade, girls begin to exceed boys in height at the age of ten years four months and are in turn surpassed by them at thirteen years, while in the five percentile grade girls do not surpass boys in height till they are eleven years five months old and boys do not regain their superiority till they are fifteen years four months of age. It will be also noticed that the duration of the period of female superiority varies quite regularly with the percentile grade, but that the variations in height and weight are in opposite directions. This is indicated by the fact that the above-mentioned dotted lines converge upward in the curves of height and downward in those of weight. In other words, we may say that, when growing children of both sexes are compared together by corresponding percentile grades, the period of female superiority in height is less conspicuous in tall than in short children, while the period

PLATE 8. (FROM TABLES 1 & 7.) BOYS ——— GIRLS - - - - -

HEIGHTS OF BOSTON SCHOOL CHILDREN.

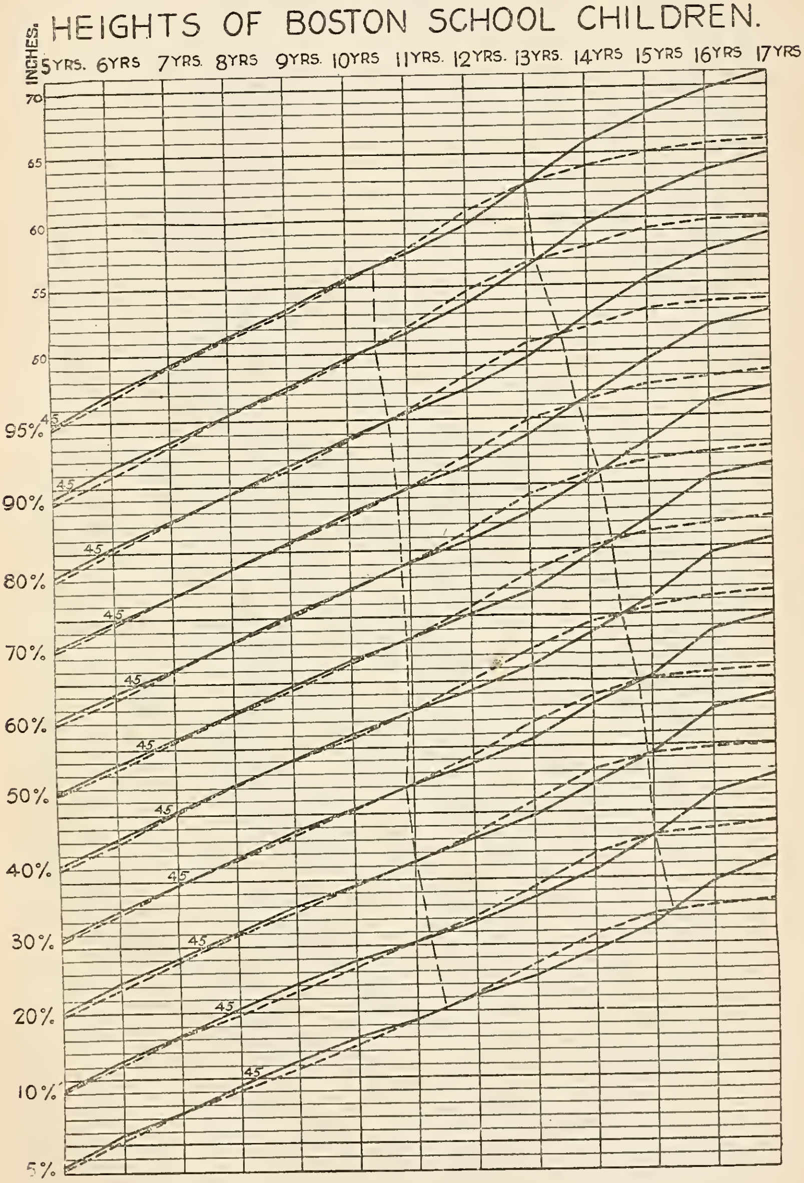
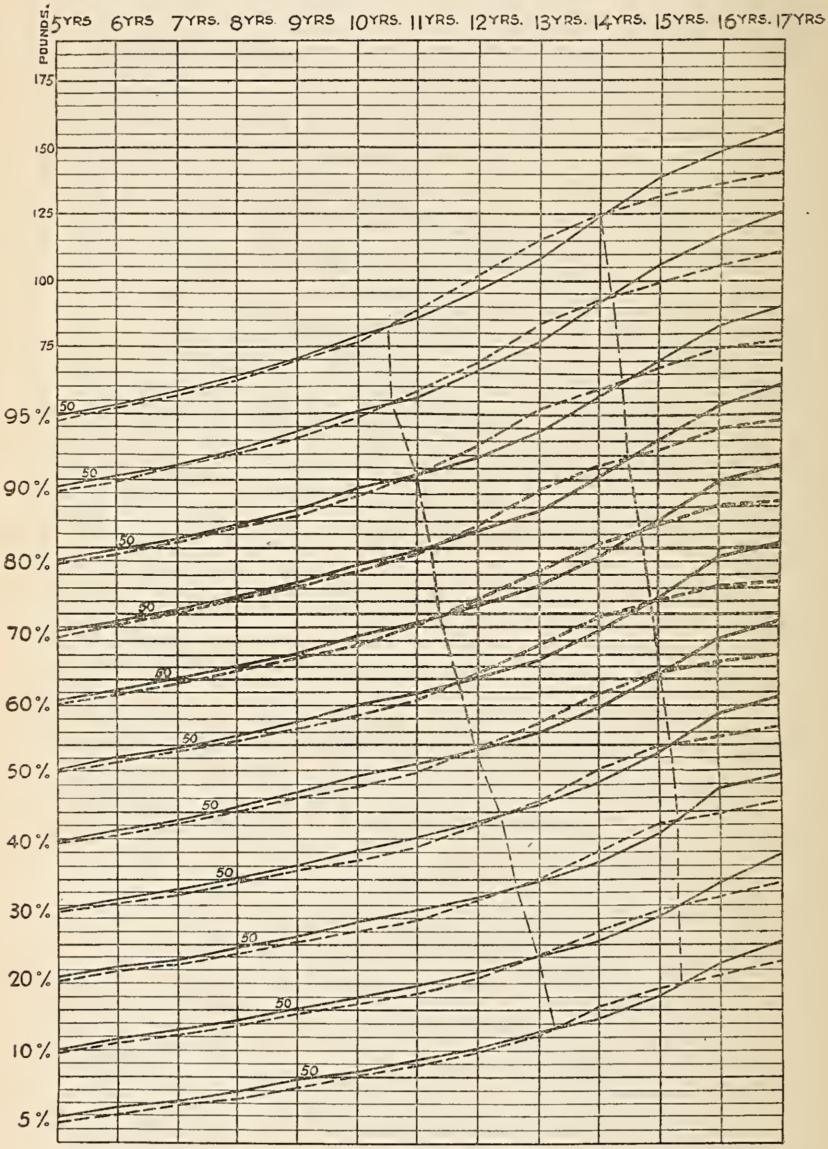


PLATE 9 (FROM TABLES 4 & 10.) BOYS —— GIRLS -----

WEIGHTS OF BOSTON SCHOOL CHILDREN



of female superiority in weight is a more marked phenomenon in heavy than in light children.

Among the advantages of this method of discussing anthropometrical results may be mentioned the facility which it affords for comparing the rates of growth of children of different nationalities by determining the percentile rank of the average children of one nationality referred to those of another nationality as a standard. We may take, for instance, the observations of Pagliani* on Italian children, and those of Erismann† on the employees in Russian factories, and calculate the percentile rank of the children at successive ages when referred to Boston children as a standard. The result of this calculation is given in the following table: —

TABLE 17. — *Showing the Percentile Rank of Italian and Russian Children compared with those of the Boston Public Schools.*

Age at Last Birthday.	Percentile Rank.			
	Italian (Pagliani).		Russian (Erismann).	
	Boys.	Girls.	Boys.	Girls.
Five,	below 5	below 5	–	–
Six,	5.6	below 5	–	–
Seven,	22.1	9.2	75.9	80.7
Eight,	26.5	15.8	56.6	63.4
Nine,	31.4	29.1	48.9	76.4
Ten,	20.0	28.0	40.6	51.9
Eleven,	16.4	25.5	42.5	48.8
Twelve,	16.1	24.1	36.6	39.0
Thirteen,	21.7	23.7	28.7	26.9
Fourteen,	21.2	30.0	26.5	22.8
Fifteen,	23.7	29.5	29.1	21.4
Sixteen,	16.2	32.4	17.7	23.4
Seventeen,	13.1	32.2	18.6	22.0
Eighteen,	6.6	34.3	15.0	23.6

An examination of this table shows that Italian children of both sexes are, in early life, very much smaller than Boston children of the same age, and, though they afterwards increase in relative size, they never reach a higher percentile than 31.4 for boys and 32.4 for girls.

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* Lo Sviluppo Umano, p. 37.

† Untersuchungen über die körperliche Entwickelung der Fabrikarbeiter in Zentralrussland, Tübingen, 1889. A very thorough investigation based upon measurements of over 100,000 individuals.

The Russian children show in general, with increasing age, a progressive diminution in percentile rank which is probably to be accounted for by the fact that during the earlier period of life only children who are unusually well developed physically are likely to find their way into manufactories. The children from seven to twelve years of age are therefore to some extent selected cases and do not represent the average development of the working population.

It will be noticed that throughout this article it has been assumed that the changes from year to year in the values of the height and weight at the various percentile grades represent the rate of growth of large, small and medium-sized children respectively. This assumption may be criticized on the ground that the values at the various percentile grades do not represent the average measurements of particular groups of growing children but are merely limiting values, on either side of which lie certain percentages of the total number of observations on children of a certain age. To determine how much importance is to be attached to this objection it will be necessary to inquire within what limits the percentile rank of a growing child may under normal circumstances vary from year to year, for it is obvious that if growing children remain practically in the same percentile grade during the whole period of adolescence a comparison of the values at the various percentile grades in successive years will, to all intents and purposes, show the annual increase in height and weight of groups of children belonging in and about those percentile grades, *i.e.*, it will really give us the rate of growth of large, small and medium-sized children. Now it is evident that a close maintenance of a given percentile rank by a growing child is by no means a universal rule, for it is a matter of common observation that very small babies sometimes grow up into very large men and women. Such cases, however, always attract attention from their obviously exceptional character and indicate that, as a rule, there is a certain degree of correspondence between the size of the child and that of the adult.

General impressions with regard to such questions are, of course, of very little value, and before any definite conclusion can be reached it will be necessary to collect large numbers of observations on growing children of both sexes, each individual being measured in successive years or, still better, several times each year, and the percentile rank at each age determined. Such determinations may be made by means of tables 1–10, or by the curves on plates 2–5 constructed from them, but in practice it will be found more convenient to make use of such curves as those on plates 10–13, which have been constructed* with a view to this special purpose.

In these plates, which have been constructed only from the tables which present the total number of observations irrespective of nationality, the age in years and months is given on the sides, the percentile rank at the top and bottom, while the curved lines traversing the plate represent successive inches or pounds. The use of the curves will be best understood by an example. Let us suppose, for instance, that a boy ten years five months old measures fifty inches in height, and it is desired to ascertain his percentile rank. On Plate 10 the horizontal line corresponding to ten years five months is to be followed to its point of intersection with the fifty-inch curve. This point of intersection will be found to lie on the vertical line corresponding to twenty-five per cent. This means that the boy is taller than twenty-five per cent. and shorter than seventy-five per cent. of the boys of his age. A height of fifty-one inches at the same age would give a percentile rank of forty-one per cent., fifty-two inches fifty-seven per cent., fifty-three inches seventy-four per cent., etc.

If we were in possession of a few hundred sets of observations on growing children, each child being measured and weighed annually or semiannually during the period of adolescence and his percentile rank determined in the

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* Such curves may be constructed by calculating for each age the percentile rank corresponding to each inch or pound by interpolation in tables such as Nos. 1–12, or, still better, from tables such as Nos. 4–15 of the original article, by direct addition to the percentages corresponding to the successive inches or pounds.

PLATE 10

SHOWING PERCENTILE RANK OF BOYS OF GIVEN AGE AND HEIGHT.

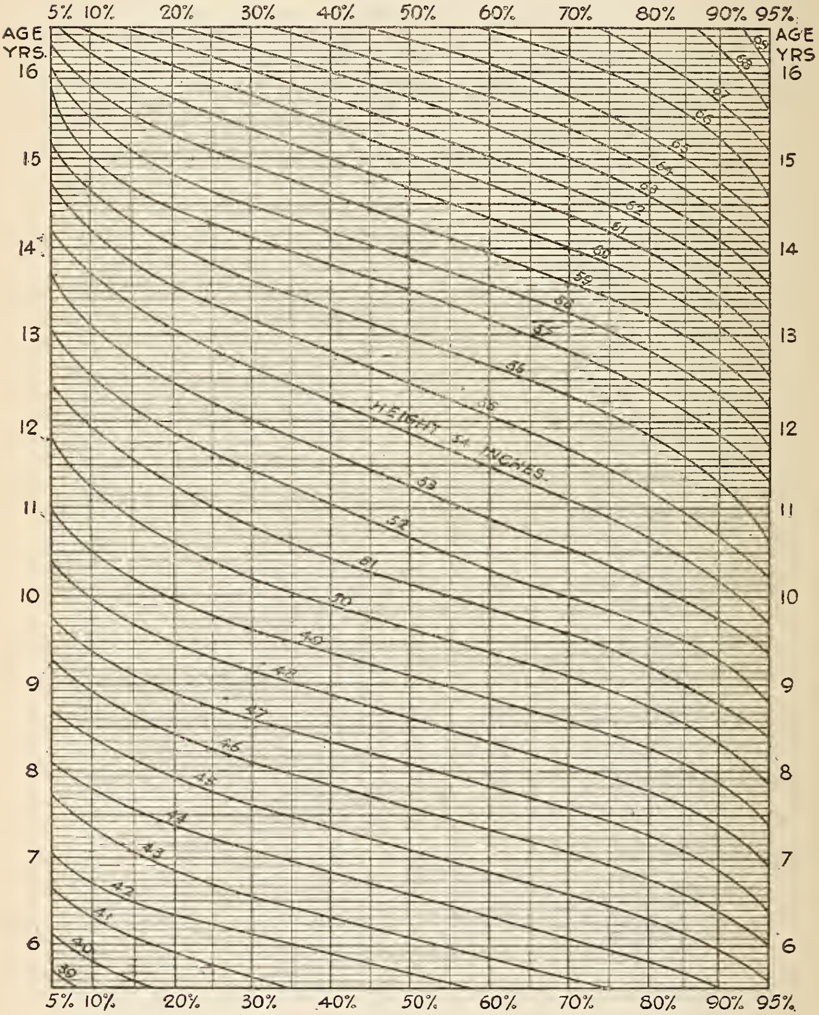


PLATE II.

SHOWING PERCENTILE RANK OF BOYS OF GIVEN AGE AND WEIGHT.

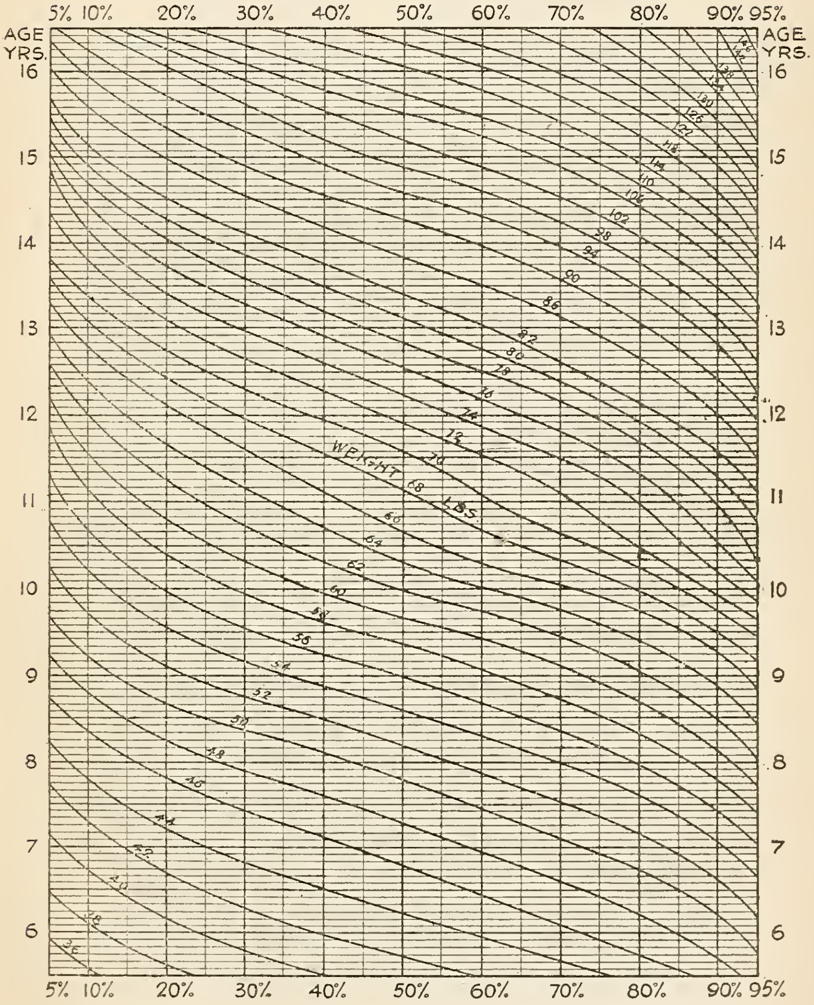


PLATE 12.

SHOWING PERCENTILE RANK OF GIRLS OF GIVEN AGE AND HEIGHT.

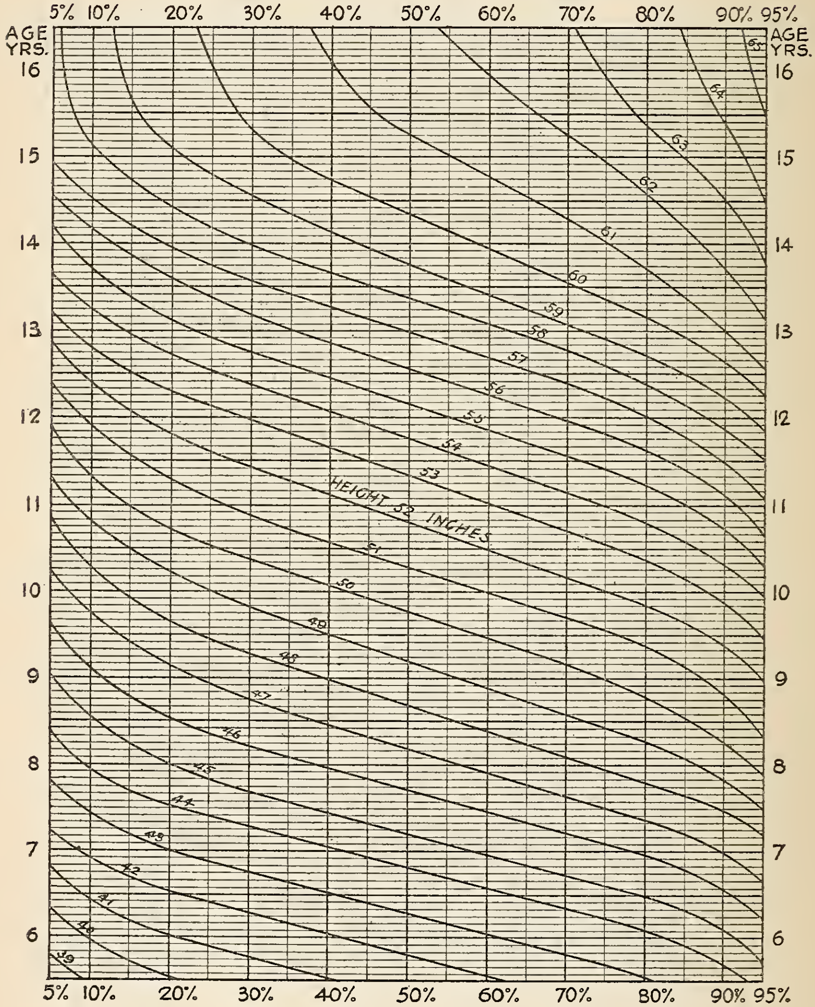
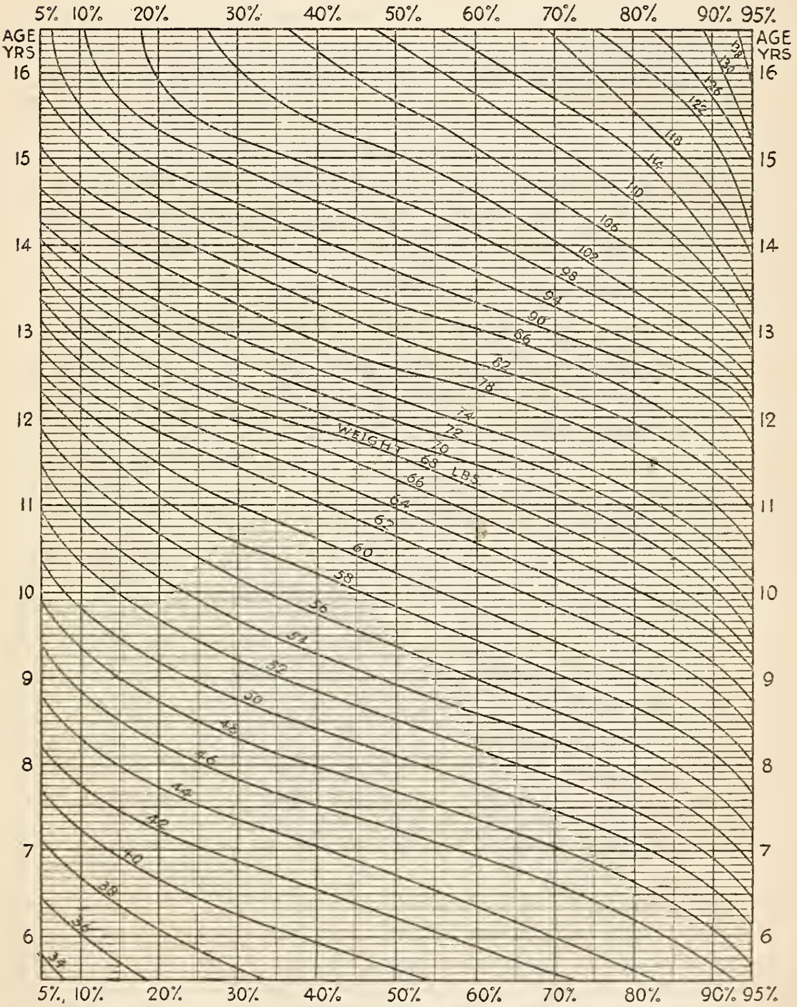


PLATE 13.

SHOWING PERCENTILE RANK OF GIRLS OF GIVEN AGE AND WEIGHT.



above manner, we should be able to draw fairly accurate conclusions as to the normal range of variation in percentile rank during the period of growth, and to determine how far the rate of growth in the earlier years of life is to be regarded as an indication of the size to be subsequently attained. Unfortunately records of this sort have been rarely kept and still more rarely published. Those which are accessible to the writer represent in most cases the result of observations upon children above the ninety-five per cent. grade in both height and weight, *i.e.*, of a size at which the above tables do not permit us to determine the percentile rank with any accuracy. As an example of the kind of record which it is important to secure the following table is presented, showing the percentile rank in height and weight of two growing girls from the ages of six to fifteen years: —

TABLE 18. *Showing Absolute Height and Weight and Percentile Rank in Height and Weight of two Girls* E *and* F *at Various Ages from Six to Fifteen Years.*

E.								F.							
AGE.		HEIGHT.		AGE.		WEIGHT.		AGE.		HEIGHT.		AGE.		WEIGHT.	
Years.	Months.	Inches.	Per Cent. Rank.	Years.	Months.	Pounds.	Per Cent. Rank.	Years.	Months.	Inches.	Per Cent. Rank.	Years.	Months.	Pounds.	Per Cent. Rank.
6	3½	45.3	89.4	6	3½	50.0	92.7	6	0	44.8	90.0	6	0	48.2	90.5
7	3½	47.6	88.1	7	3½	54.3	89.3	7	0	47.2	89.5	7	0	53.6	91.8
8	3½	49.3	82.6	8	3½	59.8	91.0	8	0	49.1	86.7	8	0	57.3	88.0
9	3½	51.2	83.8	9	6	67.3	92.0	9	0	50.8	85.5	9	0	61.1	84.2
10	3½	53.0	81.7	10	6	73.6	89.7	10	0	52.8	85.0	10	0	67.2	84.6
11	3½	55.8	85.6	11	6	84.5	90.8	11	0	55.2	86.3	11	0	77.8	88.6
12	3½	58.5	85.2	12	6	97.7	92.	12	1	57.7	89.0	12	0	88.4	88.2
13	4	61.0	85.5	13	6	110.9	91.7	12	9	59.6	84.3	13	0	100.1	85.5
14	1	61.8	83.0	14	6	129.2	95+	13	9	62.2	90.8	14	0	114.2	90.2
15	1	62.7	80.0	15	5	134.9	95+	-	-	-	-	-	-	-	-

These records are, of course, not numerous enough to justify any general conclusions, but they are interesting as showing that the percentile rank of healthy growing children may, during adolescence, vary within a range of four or five per cent. on either side of an average value. How much wider the variation may be without passing the limits of health is a question for the determination of which a very large number of observations is necessary, and it is to the public schools that we must again look for the data which shall make it possible to give a definite answer to this and other questions relating to the phenomena of growth. Meanwhile, the above-described variations during adolescence of the height and weight of children at the various percentile grades must be regarded as representing only in a general way the rate of growth of large and small children respectively.

The importance of taking periodical measurements of pupils in the public schools has frequently been urged. In fact, this branch of anthropometry stands in such close relation to physical training that it may be regarded as the test to which systems of physical training must be subjected in order to judge of their comparative efficiency. No teacher at the present day is satisfied to give instruction in any department of learning without testing its results by periodical examinations of the pupils. In the same way the director of physical training can have no certainty that his efforts are well directed unless he can convince himself, by periodical determinations of height, weight, chest girth, strength, etc., that his pupils are making satisfactory progress in physical development.

Here the question at once arises: What amount of progress is to be regarded as satisfactory? and the importance of establishing a normal standard of development becomes apparent. A rough approximation to such a standard of development in height and weight for the pupils of the Boston public schools has been given in the above tables and curves. By their means it is possible to ascertain whether a given pupil retains his rank (relative to height and weight) among his comrades during the period of adolescence. It is obvious, however, that much more valuable results could be obtained if we were in possession of observations numerous enough to justify the construction of separate tables and curves for children of different nationalities; for it has been shown that children of American parentage in our public schools are, at nearly all ages, taller and heavier than those of other nationalities. It is also of great importance that some simple tests of strength should be applied to growing children in order to establish a standard of power as well as of size. When a system of annual physical measurements shall have been introduced into our public schools and recognized as of equal importance with the annual examinations in the various studies, we shall be in a position to formulate the laws of growth with much greater accuracy than is at present possible.

TYPHOID FEVER IN ITS RELATION TO WATER SUPPLIES.

By Hiram F. Mills, A.M., C.E.,
Member of the State Board of Health of Massachusetts.

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Typhoid fever is one of the diseases now generally attributed to one of the bacteria known as the typhoid bacillus.

Bacteria are very minute vegetable growths, and this species is a rod with rounded ends, the diameter being about one thirty-thousandth of an inch and the length about one ten-thousandth of an inch. When very highly magnified, fine hair like appendages (cilia) may be seen extending from near either end.

It may not be unreasonable to think of the invisible kingdom of bacteria as consisting of as many species as the visible vegetable kingdom and all of them doing as beneficent work, in the economy of nature, as the trees and plants which we see around us; but there is a small fraction, perhaps comparable with the small number of poisonous plants, which are disease producing. The number actually known to produce disease is very small, and among those regarded as most carefully determined is the typhoid bacillus.

It is not merely held that this germ is usually associated with typhoid fever, but that typhoid fever does not exist when this germ is not in the system; that it is the actual cause of the disease. It becomes important then to determine how it can get into the system, and under what conditions it can live outside of the human body.

These questions have been and are being studied with care, but there is much yet to be learned. That these germs may be taken into the body with the food and drink appears to be well established. There appears to be no good ground for believing that they live in the air and are carried from place to place by winds; but it is not unreasonable to conclude that they may live in air long enough to be carried with dust on clothing or upon the person, from one sick-room to another, or from the sick-room to the kitchen, or to be blown about a yard where slops from a sick-room have been thrown, or blown into the windows of a sleeping-room with the dust from a privy unfortunately near.

Cases following one another in the same house have been more readily explained by such communication than by the milk or drinking water obtained from the same source as that used by neighbors who were not afflicted.

Milk has been regarded as an excellent food for the typhoid bacillus. When sterilized by heat so that all other bacteria are killed, the typhoid bacilli added to it have been found to increase one thousand-fold in twenty-four hours. Recent experiments by the Board have shown an increase of seventy-fold in sterilized milk; but in milk received from a milk wagon on the street a certain number of the typhoid bacillus added did not increase but rather decreased; and when added to milk drawn directly from the cow, either in the usual way of milking or through a sterilized tube, there was no marked change in the number in eight hours, and little if any increase in twenty-four hours. Many cases of prevailing typhoid fever in cities have been limited to a single milk route and typhoid fever has been found to have been at the farm whence the milk was brought.

In some cases the communication appeared to be through water from a well polluted by soakings from a privy where dejecta from a typhoid patient had been deposited. But the method of communication has not been determined with certainty.

Drinking water has many times been proven to be the medium by which typhoid fever has been communicated. Many marked cases have been recorded in this country and in Europe but the present object is not to repeat what is already known but to present the results of a study of the influence of the water supplies of the State of Massachusetts upon the prevalence of typhoid fever.

The highest death-rates by typhoid fever in the State are not in the cities, but are in the towns that depend for water upon wells. The five towns highest on the list, for the past eighteen years, have an average death-rate of 12.82 per year for each 10,000 inhabitants; while the five cities having the highest death-rate by typhoid fever, in the past twelve years, average 7.65 per 10,000, and the average for all of the cities of the State, in the same time, has been 4.62.

The town which had the highest death-rate from typhoid fever in the State was Ware. In the fifteen years previous to 1886 the average number of deaths by this disease in 10,000 inhabitants was 16.5. In 1886 this town introduced a supply of water and in the years since, although the water has not yet come to be generally used, the number of deaths has fallen to 6.9, or four-tenths as many as previously.

Improvement is not limited to those communities where the prevailing death-rate was high, as illustrated by the city of Newburyport, which used well water until 1881, when water was brought into the city from springs. In the nine years previous to the introduction of spring water the number of deaths yearly by typhoid fever per 10,000 inhabitants was 4.55. In the seven years since the introduction of pure water the number of deaths per 10,000 has been only 2.07, or less than half as many as previously.

The general decrease in deaths by typhoid fever, resulting from abandoning wells and introducing a public water supply, will be presented later.

Typhoid fever is properly regarded as a preventable disease, and in considering the following facts we must conclude that some of our communities have responsibilities that cannot be ignored in preventing yearly the death of many people scattered through all classes of society.

That this is to a great extent a preventable disease is shown by these general facts: Twenty-five years ago the average number of deaths by typhoid fever in 10,000 inhabitants in the places which are now cities in this State was 7.8; the number now dying yearly from this disease in the same places is 4.6 in 10,000 inhabitants. In fact, the actual number of deaths from this disease twenty-five years ago in these places, when their population was only six-tenths as much as at present, was as great as it is now; and if measures for its prevention had not been taken, and the death-rate had continued as it was twenty-five years ago, we should now have 1,000 deaths yearly, when the actual number in the cities is about 600.

With the usual number of 600 deaths in a year, in all of the cities of the State having a population of one million and one-third, we find that two of the cities having together less than one-tenth of the population have, in the twelve months ending April 1, 1891, had more than one-third as many deaths as all usually have in a year. The city of Lowell, with a population of 78,000, had, in the twelve months mentioned, 150 deaths from this disease, and the city of Lawrence, with 45,000 inhabitants, had 78 deaths. These two cities had 69 more deaths from this disease, in the twelve months, than the city of Boston with four times the population.

If these two cities had had only as many deaths as the average of the city population, the number would have been 36 in Lowell and 21 in Lawrence. There were in Lowell, in one year, 114 more deaths and in Lawrence 57 more deaths by this disease than in the usual average of the same number of inhabitants in the cities of the State.

In November, 1890, finding the number of deaths by typhoid fever in Lowell, in that month, was far exceeding that of the whole city of Boston, the State Board of Health instituted inquiries as to the cause, and soon finding that the death-rates from this disease were also rapidly increasing in Lawrence, with no similar increase in other cities of the State, these two cities were made the subject of especial study by the Board.

The most probable cause of such an epidemic was thought to be the contamination by the typhoid bacillus of the milk supply or of the water supply.

By carefully plotting upon maps of the cities the residence of all cases reported to the local board of health, together with the deaths, the distribution, though not even over the whole city nor strictly proportioned to the density of population, was so general that it could not be attributed to possible cases of typhoid fever at two or three of the large number of farms that supplied milk to the one hundred or two hundred milkmen who distributed milk through the territory where the cases of disease were found.

On the other hand the cases found in Lawrence were all within the territory supplied with water from the city water works, and several of the cases were in the thinly settled and apparently very healthy portions of the city, near the outer limits of the water pipes.

In Lowell the cases were very generally distributed throughout the territory, the numbers following nearly the density of the population.

These conditions and the discovery of a probable cause of the contamination of the Lowell water supply by fæces of typhoid patients discharged into Stony Brook only three miles up stream from the intake of the Lowell water works, followed in a few weeks by the very rapid increase in the number of deaths by typhoid fever in Lowell; and these deaths followed in about six weeks by an alarming increase in the number of deaths in Lawrence, whose water supply is drawn from the Merrimack River, nine miles down stream from where the Lowell sewage enters the river; and the further discovery in December of typhoid-fever germs in water from the service pipes of the city of Lawrence, induced the Board to send to the mayor of Lawrence the following advice: —

STATE BOARD OF HEALTH, LAWRENCE, Jan. 10, 1891.

Hon. LEWIS P. COLLINS, *Mayor of Lawrence.*

DEAR SIR: — The State Board of Health has been engaged many weeks in seeking the cause of the prevalence of typhoid fever in Lawrence; and, although the investigation is not completed, the facts obtained point so strongly to the city water as being one important cause that the Board feels warranted in warning the citizens not to use it for drinking until after it has been boiled at least fifteen minutes; and that when boiled it should not be cooled by putting into it ice obtained from the river this winter. This precaution should be continued as long as typhoid fever prevails in Lowell.

Very respectfully,

HIRAM F. MILLS,
Chairman Committee on Water Supply and Sewerage of State Board of Health.

On the same day a similar letter was mailed to Hon. Geo. W. Fifield, mayor of Lowell, in regard to the relation of the Merrimack River water to typhoid fever in Lowell, with the same warning.

As resort was had to wells in Lawrence the mayor was notified of those wells, used in part by the public, which the chemists of the Board regarded unsafe to use on account of pollution by sewage; and different sources were selected from which water of good quality could be distributed to the schools.

Whenever the Board was notified that wells in the city were used by more than one family the water was analyzed without charge, and the users were informed whether it was suitable to drink or not.

In the latter part of January, 1891, the mayor of Lawrence requested the chairman of the committee on Water Supply of the State Board of Health to meet the city committee on water works and others in the discussion of questions concerning the city's water supply, and received the following response: —

COMMONWEALTH OF MASSACHUSETTS,
STATE BOARD OF HEALTH, LAWRENCE, Jan. 30, 1891.

Hon. LEWIS P. COLLINS, *Mayor of Lawrence.*

DEAR SIR: — I have received your invitation to represent the State Board of Health in a meeting with the city committee on water works and others, at an early day, to discuss the questions that may arise concerning the city's water supply.

The State Board of Health is required to consult with and advise the authorities of cities intending to introduce a system of water supply as to the most appropriate source of supply and the best practicable method of assuring the purity thereof; and such cities are required to submit to the Board, for its advice, outlines of their proposed plans in relation to a water supply; and its recommendations and advice must accompany any petition the city may make to the legislature for authority to introduce a supply.

The method of the Board, after receiving the plans of the city, is to have the subject in all its bearings made a special study by its own engineers, looking to the city to supply local facts and to make the desired investigations of localities. The report of the engineers of the Board is then considered by the committee having this subject in charge, and conclusions are recommended to the Board for its adoption.

You will see that no one can be authorized to represent the Board upon any case before its investigations have been made, and you will recognize the impropriety of any member of the Board recommending any one system, before investigation, when all of the systems which the city may present are to come before him for judgment.

The Board is, however, desirous of aiding you in every way, and as it has already considered some of the points which will come before you, I will present some of the facts which have been collected in anticipation of your call for advice.

Typhoid fever is one of the preventable diseases and, in considering steps to be taken for its future prevention, the question of first importance is whether the cause of the prevailing sickness is temporary and exceptional, or continues from year to year.

From the registration reports we find that for the twelve years from 1878 to 1889 the yearly average number of deaths from typhoid fever in all of the places in the State which are now cities has been 4.62 deaths for each 10,000 inhabitants.

The number of such deaths in each of the cities may be found in the following table: —

Average Number of Deaths in the Cities of Massachusetts by Typhoid Fever per Year for each 10,000 Inhabitants for the Twelve Years 1878 to 1889.

Holyoke,	8.93	Brockton,	4.01
Lawrence,	8.33	Lynn,	3.87
Lowell,	7.63	New Bedford,	3.80
Chicopee,	7.05	Newton,	3.65
Fall River,	6.32	Malden,	3.54
Springfield,	5.29	Worcester,	3.33
Taunton,	5.02	Newburyport,	3.25
Haverhill,	4.83	Cambridge,	3.23
Quincy,	4.68	Gloucester,	3.23
Pittsfield,	4.63	Fitchburg,	3.16
Marlborough,	4.59	Woburn,	2.95
Salem,	4.55	Somerville,	2.95
Boston,	4.32	Chelsea,	2.89
Northampton,	4.04	Waltham,	2.42

All of the cities, ... 4.62

In this period of twelve years Lawrence stands next to the highest, with a yearly death-rate, from this cause, of 8.33 per 10,000, and Lowell follows next with 7.63.

There are four cities larger than Lawrence, viz.: Boston, Worcester, Cambridge and Lynn, whose yearly death-rate from typhoid fever averaged 3.91 per 10,000, or less than one-half that of Lawrence, and the death-rate from this disease in Lawrence was nearly double that of the average of the cities of the State.

The deaths of the past year are not included, in order that we may see the relative position of Lawrence in ordinary years.

Turning again to the tables, to see if the condition of Lawrence is improving or deteriorating, we find the following average death-rates from typhoid fever per 10,000 living, for the four years 1886 to 1889 : —

Lawrence,	10.30	Haverhill,	4.98
Lowell,	9.55	Boston,	4.05
Fall River,	6.40	Cambridge,	3.80
Holyoke,	6.13	Worcester,	3.11
Chicopee,	6.06	Lynn,	2.24

The average for all of the cities in these four years was 4.59.

Here we find Lawrence in these four years (next previous to and not including the last year) with the greatest death-rate from typhoid fever of any city in the State, amounting to 10.30 deaths yearly for each 10,000 inhabitants, followed closely by Lowell with 9.55, and then by Fall River with less than two-thirds as many.

Lawrence here has more than three times as many deaths by this disease, for the same number of inhabitants, as the average of the four larger cities of Boston, Cambridge, Worcester and Lynn, and more than twice the average of the cities of the State.

It is to be noticed that the five cities having the highest death-rate from this disease are manufacturing cities, and there may be reason in attributing a part of the cause to the mode of life in such cities, being poorly adapted to care in sickness ; but on the other hand it may be seen by the last report of the Board, page 395, that the mortality-rates of Lawrence, since it became a city, compare favorably with the mortality-rates of the city population of the State taken as a whole.

The diseases in which the death-rate of Lawrence especially exceeds that of other cities are typhoid fever and diarrhœal diseases, both of which are regarded as especially dependent upon the water used for drinking.

Comparing these manufacturing cities we find there are twenty more deaths by typhoid fever, each year, in Lawrence than in the same number of inhabitants in Fall River ; and in Lowell the condition is but little better than in Lawrence.

These two cities, Lowell and Lawrence, both well situated, well regulated and comparing favorably for general healthfulness with other cities in the State, have fifty per cent. more deaths by typhoid fever, for the same population, than any other cities in the State.

These are the only two cities in the State which draw their water for drinking from a river, into which, within twenty miles above, sewage is publicly discharged.

Within nine miles above the Lawrence water works are the Lowell sewers, and within nine miles of the Lowell water works is the State line, with the city of Nashua five miles beyond. Sewage from towns in Massachusetts on the Nashua River is freely turned into New Hampshire, and thence into the Merrimack River; and sewage from nearly one-half of the State of New Hampshire enters by the Merrimack River and flows through Massachusetts, past the cities of Lowell and Lawrence. Having no means of checking the entrance of the latter pollution was probably the controlling reason why the Commonwealth in 1878 — six years after granting to the city of Lawrence the right to introduce its water for drinking — by special statute made this river a free receptacle for sewage.

The amount of sewage that has directly entered the river and its branches during the chemical examinations of the past three years is estimated to be about one gallon in six hundred gallons of the river water passing Lawrence, and there has been no more impurity in the water that could be detected by chemical analysis than in about one-half of the drinking water supplies of the State obtained from ponds and streams; but the facts which have been presented showing that these two cities have so much higher death-rate from typhoid fever than any other cities of the State, together with what is known of the relation of typhoid fever to sewage-polluted drinking water, are the strongest grounds for concluding that even with the small amount of organic impurity in the water, as shown by chemical analysis, the disease germs of this disease are able to pass and do pass from one city to the other in the water of this river.

You desired to know if the water could be purified by filtration. It would be essential in this case that the germs of this and other diseases should be destroyed by the process of filtration. Of the many filters which the State Board of Health has experimented with there is one which has filtered daily for three years at the rate of about 300,000 gallons per acre per day, and it is believed that no bacteria have survived the passage through it. Such a filter would have to cover an area of ten acres to purify the 3,000,000 gallons daily required for Lawrence.

Of the more rapid filters the Board has not yet found one, used either with or without alum, that removed all the bacteria.

It is evident that there will be difficulty in finding near Lawrence a new source of supply sufficiently abundant for all purposes, and so situated as to be in the future sufficiently pure for drinking. Such a source would be preferable to any other and should be sought; but if it cannot be obtained without too great expense, it will be well to consider and have definite estimates of cost made for a system introducing pure spring water, to be distributed over the city in a separate system of small pipes, to be used exclusively for cooking and drinking; thus leaving the present well-established system of water works to be used for all other purposes, including the extinguishing of fires, all business and manufacturing purposes, watering of streets and gardens, and domestic purposes except cooking and drinking.

The quantity required of pure water would probably not exceed five per cent. of the full quantity for all purposes, and it is quite probable that a tract of land, within reasonable distance from the city, may be found which will supply this quantity of water and which can be controlled by the city and kept free from future pollution.

That you may have definite knowledge of the relation of typhoid fever to drinking water I present the following experience of the cities of this State.

More than one-half of the cities of the State had public water supplies introduced within the years from 1869 to 1877. In the table below are given the number of deaths from typhoid fever yearly in 10,000 inhabitants, in each of the cities introducing water in the above period, for the ten years previous to the period and for the twelve years following it: —

CITIES.	Yearly Number of Deaths by Typhoid Fever per 10,000 People, 1859 to 1868.	Date of Introduction of Water Supply.	Yearly Number of Deaths by Typhoid Fever per 10,000 People, 1878 to 1889.	Percentage Deaths in the Latter Period are of those in the Former.
Holyoke,	6.73	1873	8.93	133
Lawrence,	8.34	1875	8.33	100
Lowell,	6.16	1872	7.63	124
Fall River,	7.78	1874	6.32	81
Springfield,	9.67	1875	5.29	55
Taunton,	6.12	1876	5.02	82
Northampton,	10.98	1871	4.04	37
Lynn,	9.06	1871	3.87	43
New Bedford,	7.77	1869	3.80	49
Newton,	6.57	1876	3.65	56
Malden,	8.04	1870	3.54	44
Fitchburg,	10.59	1872	3.16	30
Woburn,	8.29	1873	2.95	36
Somerville,	4.28	1867	2.95	69
Chelsea,	5.97	1867	2.89	48
Waltham,	8.12	1873	2.42	30

Of these sixteen cities all but three had less typhoid fever after introducing public water supplies than before; and their average number of deaths from this cause was less than one-half of the number of deaths when they used water from wells.

The three exceptional cities are Holyoke, Lawrence and Lowell, whose death-rate from typhoid fever in the above period, since the introduction of water, has not been less than previously.

Holyoke, though receiving water from an outside source for general use, has used, to some extent in the mills, water from the canals filtered through gravel beds in the bottom of the canal, or through some of the rapid filters used by paper mills. No investigations have yet been made to learn whether the people using the canal water in this way are more afflicted with typhoid fever than others, and it is a fact that during the past five years, since the canal water has been more carefully filtered than formerly, the death-rate in Holyoke from this disease, though still high, is lower than in previous years.

The continued high death-rate from this disease in Lawrence and Lowell, which, as before stated, has, in the four years previous to the last, put them far beyond all of the other cities of the State, must, in large measure, in the light of the experience of the other cities, be attributed to the polluted water supply. And the experience of the others gives promise that, with a pure water supply, the death-rate by this disease may be reduced by one-half.

Respectfully yours,

HIRAM F. MILLS,
Chairman Committee on Water Supply of
State Board of Health.

Since the above letter was sent to the mayor of Lawrence more extended inquiry has been made of the conditions at Holyoke. From examinations made by the secretary of the Board and from a very elaborate report made by Mr. Geo. V. McLauthlin it appears that one of the main sewers of the city discharges into the river a short distance above the entrance to the upper canal; nearly all of the sewage from the factories enters the canals directly, and the water used for drinking in the factories is from three sources, viz.: the public water supply, which has very slight liability of being contaminated; water from the canals either direct or after passing through rapid filters, and water from wells in the factory yards which comes indirectly from the canals and is partially filtered by flowing through the ground. The last source appears to be the one most commonly used in the factories in summer because the water is cooler than the city water; and for the same reason water from the canal, either directly or after passing through rapid filters, is used in many of the mills in winter.

By comparing the death-rates by typhoid fever among those of different occupations in Holyoke the remarkable result is brought out that for the last three years the death-rates from this disease among those employed in mills which use canal water for any purpose averaged more than three times as high as among all other persons.

The very high death-rates by typhoid fever of 17 and 24 per 10,000 in 1881 and 1882, when included in an average, place Holyoke at the head of the list of Massachusetts cities having the greatest mortality from this disease, but the average for the past eight years places it below two other cities and shows that it is having about fifty per cent. more deaths from this disease than the average of the same city population.

The cause of the epidemic of 1881 and 1882 has been sought, but without satisfactory result. Inquiry was limited in part by the fact that the detailed death returns of those years have been destroyed, but enough data have been collected to show that it was almost wholly an epidemic among mill operatives.

While Mr. McLauthlin was making his examination in Holyoke, the local board of health, having been notified by Professor Sedgwick, the bacteriologist of the State Board, of the practice of drinking canal water in the mills and the dangers attending it, engaged Mr. McLauthlin to have warnings attached to all of the canal water faucets in the mills. This required 237 brass clamps on which was stamped, "Canal. Do not drink." Other outlets were provided with 169 brass plates having the same advice. Similar warnings printed on placards, in English and French, to the number of 260, were posted where canal water was accessible.

The Milk Supply of Lawrence.

If the epidemic in Lawrence had originated in a contaminated milk supply we should expect to find typhoid fever prevailing at many of the farms from which the milk was brought.

In order to determine whether typhoid fever existed at any of the farms from which milk brought into Lawrence was obtained, the Board engaged the inspector of milk of Lawrence, Mr. P. H. Donoghue, to learn from each milkman the farms from which he obtained milk and to learn from various sources if there were any cases of sickness at any of these farms. One hundred and eleven milkmen were examined who brought milk from about two hundred and fifty farms.

Three cases of typhoid fever were reported; two of them were found by the secretary of the Board, upon consultation with the physicians who attended the patients, to be other diseases than typhoid fever. One only proved to be this disease, and this one was of a man who collected swill in Lawrence and was taken ill Dec. 20, 1890, when the epidemic was at its height in Lawrence, and the disease was probably contracted there. From careful inquiry by the secretary of the physicians in the towns surrounding Lawrence, he concluded that the above was the only case of typhoid fever upon a milk farm supplying milk to Lawrence in 1890.

These results, in connection with the statements previously made, show conclusively that the epidemic in Lawrence was not caused by a contaminated milk supply.

Deaths in Boston, Lowell and Lawrence.

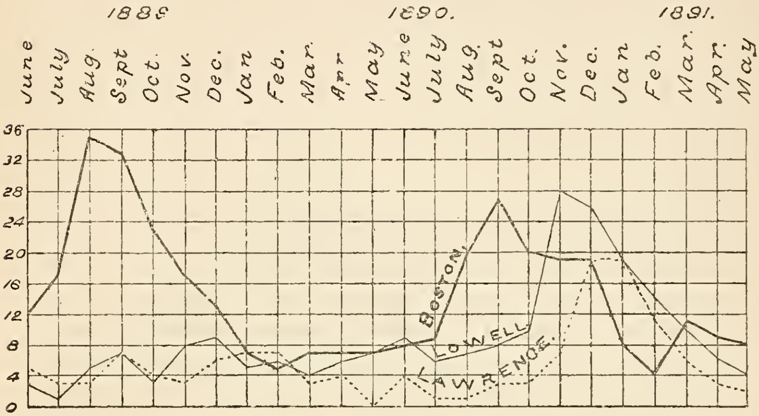
General statements have been made of the relative number of deaths by typhoid fever in Boston, Lowell and Lawrence in the twelve months, including the epidemic in the two latter cities. Additional information may be obtained by considering the deaths in these cities from this disease month by month in the past two years.

The actual numbers of deaths from typhoid fever in each of these cities in each month of the past two years are given in the following table, together with the population in 1890 and the number of deaths in 100,000 inhabitants: —

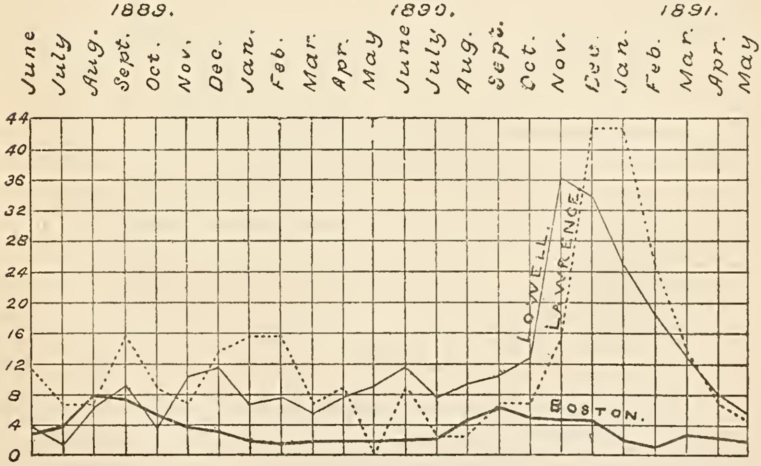
	BOSTON.		LOWELL.		LAWRENCE.	
Population in 1890,	437,245		77,605		44,559	
	Deaths.	Deaths per 100,000.	Deaths.	Deaths per 100,000.	Deaths.	Deaths per 100,000.
1889.						
June,	12	2.75	3	3.87	5	11.22
July,	17	3.88	1	1.29	3	6.73
August,	35	8.01	5	6.44	3	6.73
September,	33	7.55	7	9.02	7	15.71
October,	23	5.26	3	3.87	4	8.98
November,	17	3.88	8	10.31	3	6.73
December,	13	2.97	9	11.60	6	13.46
1890.						
January,	7	1.60	5	6.44	7	15.71
February,	5	1.15	6	7.73	7	15.71
March,	7	1.60	4	5.15	3	6.73
April,	7	1.60	6	7.73	4	8.98
May,	7	1.60	7	9.02	0	0
June,	8	1.83	9	11.60	4	8.98
July,	9	2.06	6	7.73	1	2.24
August,	20	4.58	7	9.02	1	2.24
September,	27	6.18	8	10.31	3	6.73
October,	20	4.58	10	12.88	3	6.73
November,	19	4.34	28	36.08	7	15.71
December,	19	4.34	26	33.51	19	42.64
1891.						
January,	8	1.83	19	24.48	19	42.64
February,	4	.91	14	18.02	11	24.69
March,	11	2.51	10	12.88	6	13.46
April,	9	2.06	6	7.73	3	6.73
May,	8	1.83	4	5.15	2	4.49

The same data are presented graphically in the following diagrams: —

Actual number of Deaths from Typhoid Fever in each month in Boston. Lowell and Lawrence



Number of Deaths from Typhoid Fever in 100,000 inhabitants for each month in Boston, Lowell and Lawrence.



The highest death-rates from typhoid fever in the State are, in general, in the months of September and October, August and November being a little below the highest. The death-rates in Lowell and Lawrence are, in these months, as high as in the other cities; but in these two years these are followed in Lowell by still higher death-rates in November and December, and in Lawrence by maximum rates in December, January and February. Lowell's maximum is at the time when it would exist if resulting from prevalence of the disease in other towns having the maximum at the usual time; and the maximum of Lawrence is when other cities are nearly at their minimum, and follows a month or two after Lowell, as it would if resulting from prevalence of the disease in Lowell. But we are not limited to so general a view in the case of the epidemic of 1890–91. In this case the Board found that in the months of August, September and October there were four cases of typhoid fever about three miles up the river from the intake of the Lowell water works, whose dejecta are known to have gone into Stony Brook a short distance above its entrance into Merrimack River. Previous to this time the monthly deaths from typhoid fever in Lowell had been 7. In September the number of deaths was 8, in October 10, and in November 28, followed in December by 26, in January by 19, and in February by 14. The actual number of deaths in the six months was greater than the number in the city of Boston, and the average death-rate was six times as great.

The effect of each of the several pollutions of the water at Stony Brook by the dejecta of typhoid-fever patients has been carefully traced in the increase of cases of sickness in Lowell by Prof. William T. Sedgwick, and published in "A Report upon the Sanitary Condition of the Water Supply of Lowell, Mass.," presented to the water board of Lowell April 10, 1891. Professor Sedgwick concludes as follows: —

> From prolonged personal investigation of the detailed history of the Stony Brook cases; from their unmistakable relations to the epidemic, which are well shown upon the several diagrams; and in the total absence of any other known or probable cause, I am convinced that the infection of Stony Brook and the Merrimack River by these cases was the principal cause of the epidemic of typhoid fever in Lowell (and indirectly of that in Lawrence) in 1890–91.

Turning to the table and diagram of the death-rates in Lawrence, we find that in December, 1889, and January and February, 1890, following a month after the high death-rates of Lowell for that year, the death-rates of Lawrence from typhoid fever were higher than those of Lowell, and eight times as high as in Boston in the same months. During the next six months, through the spring and summer, the death-rate in Lawrence from typhoid fever averaged about twice that of Boston, and when Boston reached its maximum in the fall, Lawrence had about the same rates; but then followed the great increase in death-rates in Lawrence, being about four times that of Boston in November, ten times that in December, and (owing to the decreasing rates in Boston as usual at that season of the year) amounting to about twenty times that of Boston in January and February.

These high death-rates from typhoid fever in Lawrence occur at a time when there is very little of this disease in other cities except Lowell, and they follow this year, as in the previous year, about a month later than the high death-rates of Lowell.

These conditions all lead to the conclusion that the excess of typhoid fever continually prevailing in Lawrence follows from and is due to the existence of the disease in Lowell, and that the prevailing excess in Lowell is due to the existence of the disease in the towns up the river which discharge sewage into the river.

The question naturally arises, whether typhoid-fever germs which grow in the human body at blood heat will survive in water at a temperature a little above freezing long enough to pass from Lowell sewers to the service-pipes of the city of Lawrence. The temperature of the river water in November, 1890, was from 45° to 35° F.; the distance from the sewers in Lowell to the intake of the Lawrence water works is nine miles, and the time for the water to pass from the sewers to the intake was at that time less than eight hours. Entering the reservoir the same day, the water would reach the outlet and enter the service-pipes within ten days, — most of it within a week. It would then be distributed over the city, in the portions near the reservoir, in about one week from leaving the sewers of Lowell, and in more remote parts of the city in about two weeks.

To prove whether typhoid-fever germs would survive in the Merrimack River water, when at the low temperature of the month of November, long enough to pass from the Lowell sewers to the service-pipes in Lawrence, a series of experiments was made by the Board by inoculating water from the service-pipes with typhoid-fever germs, and keeping the water in a bottle surrounded by ice, at as near freezing as practicable, for a month, and each day taking out one cubic centimeter and determining the number of typhoid germs. The number continually decreased, but some survived twenty-four days.

On the first day there were	6,120	germs.
the fifth day there were	3,100	"
the tenth day there were	490	"
the fifteenth day there were	100	"
the twentieth day there were	17	"
the twenty-fifth day there were	0	"

This experiment indicates that typhoid-fever germs from the sewers of Lowell may live in winter to enter the Lawrence reservoir in large numbers; that the numbers will decrease in the reservoir; but still a considerable fraction will live to enter the service-pipes, and that this fraction will decrease as the water proceeds in the pipes across the city.

This latter reduction is the probable explanation of the fact brought out by plotting the cases for three months in the fall of 1890, at their several locations upon a map of the city, that much the larger number of cases were in portions of the city near the reservoir; but that some germs survived the passage through the pipes was proven by their being found in water drawn from the service-pipes in December, 1890, at the Experiment Station, which is across the city from the reservoir, distant about two and a half miles.

We have found this relation existing between typhoid fever and water supply, viz.: that in general, in the cities of the State, the death-rate by typhoid fever has been greatly reduced by the introduction of a pure public water supply; that in the one city where there has not been such a reduction, a portion of the people use, for drinking, water from canals or from wells subjected to serious pollution by sewage; and that the deaths from this disease are much more frequent among that portion of the community than among others.

The only two remaining cities which have not decreased death-rates by typhoid fever after the introduction of public water supplies receive their supplies from a river polluted by sewage; and the seasons in which this disease prevails in these cities are later than those of other cities, and in the lower city on the river later than in the upper city, at a season when other cities are nearly free from the disease and at the time when it would follow if produced by the sewage from the upper city; further, that when the water of the river which passed the upper city and received its sewage during the greatest prevalence of the disease there had reached the service-pipes of the lower city, and there was the greatest prevalence of the disease in the lower city, typhoid-fever germs were found in water from these service-pipes.

HEALTH OF TOWNS.

HEALTH OF TOWNS.

The following digest has been compiled from such reports as have been transmitted to the office of the State Board of Health.

It is a matter of regret, not so much that the local health authorities of many cities and towns fail to forward copies of their reports to the State Board, as that very many of the local boards of health make no reports whatever, even to their own municipalities. The need of legislation which shall provide an independent board of health for all towns, or at least for the large towns, becomes yearly more apparent, and has received sufficient comment, in previous reports of the Board.

ABINGTON.

Twelve cases of contagious diseases were reported by physicians, viz.: scarlatina, 6; diphtheria, 4; typhoid fever, 1; measles, 1.

A number of complaints were made to the Board, of nuisances existing, and in all cases the Board made a personal investigation and abated the nuisance. We will continue to receive such complaints until the town adopts some form of sewerage to carry off the surplus water. During the excessive rainfall last summer and fall the cellars of a great many houses were half filled with water; there were no cesspools to receive the water from the sinks; instead, shallow drains were dug to carry away the sink water, which was then allowed to flow upon the land, in close proximity to the houses; and in the summer time this was the cause of numerous complaints, on account of the odors arising therefrom. We acquainted the owners of the condition of affairs, and they were perfectly willing to remedy the evil. They dug cesspools, but on account of the excessive rainfall it would necessitate their emptying every few days, which would be an absolute impossibility. We know of no way of combating this evil except by digging a large drain, which would carry away all the surplus water. One of the owners was willing to co-operate with the others and do this, and we expect to see it finished in the near future.

AMESBURY.

The most difficult problem of all to solve is, how to dispose of the sewage to the best advantage. In most of the streets there are no proper sewers, and as a matter of economy the town should commence to build its system of drainage on the east side at once, and not wait until compelled to by the visitation of an epidemic of contagious diseases. No interest of the town is more important than the health of its inhabitants. The introduction of public sewers is a matter of necessity as important as that of the introduction of pure water; and in the case of our village, with its hard, clayey soil, its compact population, its narrow streets and lanes, the building of large blocks of stores and carriage factories, and the consequent increase of sewage attending them, a system of sewers is a matter that must be attended to sooner or later.

The present sewers are clearly inefficient, improperly constructed and with no general plan, their outlets being, in many cases, a public nuisance. An unhealthy town is not likely to increase in wealth and population, as it will be avoided by those seeking to establish new industries, and also by those intending to make this place their home. Sixty-one complaints have been made to the Board, of nuisances which, in most instances, have been promptly abated by the owners of the premises. The number of contagious diseases reported has been 59. Diphtheria, 33; scarlet-fever, 7; typhoid fever, 18; measles, 1. There has been an increase over last year in the number of cases of diphtheria, while there has been a less number of cases of typhoid fever.

ATTLEBOROUGH.

The vote of the Fire District Association authorizing the construction of a large tank on Capron's Hill for the storage of water indicates a continuance of the present source of supply. This being so, every precaution to prevent the contamination of the well should be adopted. The proposed sewer on North Main Street would be an important factor in such improvement if the residents on the street, especially those on the westerly side, would connect their premises with it. We have the authority of the State Board of Health that the residences on the hill constitute another probable source of contamination. This should be considered by the town and proper preventive measures adopted.

During the year several cases of glanders existed among the horses in town. As far as they came to the attention of the Board the Cattle Commissioners were notified, and an official visit by one of them was promptly made. Citizens do not seem to be aware that they are obliged by law to report suspicious cases of disease among animals.

Contagious diseases reported: diphtheria, 13; scarlet-fever, 3; typhoid fever, 20; total, 36.

Ayer.

There have been reported to the Board 5 cases of diphtheria, 1 of scarlet-fever, 5 of typhoid fever, and 3 of measles; of the 14 cases 1 only was fatal, a case of diphtheria. Two of the cases of typhoid fever originating in town occurred in houses where well water was used for domestic purposes, both located on streets having the public water supply.

There is one matter which the Board feels in duty bound to bring to the attention of the public, — the disposition of the sink water in certain portions of our village. At present it is emptied into the streets, partly into closed and partly into open drains. This is an unsightly as well as unsanitary method of disposing of that portion of the sewage, and sooner or later will show its evil effects upon the public health. At present perhaps it is only a nuisance, uncleanly and disagreeable. The town has no systems of sewers and from necessity can have none, even in the near future.

Belmont.

There have been 15 cases of contagious diseases reported during the year: diphtheria, 4 cases; scarlet-fever, 2 cases; measles, 2 cases. One case of diphtheria proved fatal.

Beverly.

There were 25 cases of scarlet-fever and no deaths, 9 cases of diphtheria and no deaths. The inhabitants of the town have generally complied very cheerfully with the regulations of the Board.

Boston.

The general health of the city during 1890 was exceptionally good. The deaths were 10,181 and the death-rate 22.7 per 1,000 of the population, a lower rate than that of either 1889, or the average of the previous ten years, notwithstanding the fact that the serious epidemic of influenza in January carried off 550 people. Zymotic diseases caused 16.47 per cent. of the total mortality.

The percentage of deaths of children under five years was 32.89, the lowest since the establishment of the present Board.

The most destructive causes of death were in the following order: —

Phthisis.
Pneumonia.
Heart diseases.
Cholera infantum.
Bronchitis.
Deaths from violence.
Diphtheria.

The number of cases of contagious diseases reported to the Board in 1890 was 4,370 as compared with 5,758 in 1889, and the deaths from the same were 617 as compared with 823 in 1889. Scarlet-fever was more prevalent, measles and typhoid fever less prevalent. There was one case only of small-pox ; not fatal.

Tables are presented, giving the results of house-to-house inspections in eleven wards of the city, the whole number examined being 553 ; the principal defects found were bad odors, defective drains and traps, offensive water-closets, vaults and cesspools.

Ninety houses were ordered to be vacated, of which only 22 were actually vacated, the remainder being put in proper order by owners. Disinfectants were applied in over 93,000 places during the year.

The number of houses disinfected, mostly on account of occurrence of infectious diseases, was 1,859, and the number of rooms 4,300, for which purpose about 6 tons of sulphur were used. The principal diseases on account of which this was done were diphtheria and scarlet-fever, 1,147 of the former and 656 of the latter.

One thousand three hundred and eleven vaults and cesspools were cleansed and 745 privy-vaults were abolished and streets supplied with sewers.

One hundred and seventy-nine school-houses were inspected during the year, the principal defect found being lack of good ventilation.

A petition having been received for the abatement of an alleged nuisance caused by the Bay State Gas Works, the Board caused an investigation to be made by which such nuisance was shown to exist. After correspondence with the Board the gas company introduced various appliances to remedy the evil.

In regard to the disposal of garbage the Board strongly recommends its cremation by families, by means of the heat of the kitchen fire.

The number of persons, male and female, who used the public baths during the season (June, July, August and September) was nearly one million (988,078).

An advanced case of leprosy arrived from Sweden in April, and after detention at the quarantine station was returned to Sweden under the authority of the United States laws.

Two boys arrived from Surinam in June with a history of leprosy in the father. Their destination was Newton, and they were then placed under surveillance. In October one of these boys presented symptoms of leprosy and they were both returned to Surinam by their guardians.

The number of persons vaccinated by the Board was 3,323, and

1,959 certificates of admission to the public schools were given. Fifty cases of eruptive diseases were reported as small-pox. On examination only one of them proved to be small-pox.

The report of the inspector of animals at the abattoir shows that 28,296 head of cattle were killed, 37,133 calves, and 491,406 sheep, of which 33 cattle, 50 calves and 12 sheep were condemned, principally on account of the following diseases: tuberculosis, 17; anthrax, 4; septicæmia, 3; and Texas fever, 2.

One inspector makes special comment upon tuberculosis. Upon this point he makes the following comments: —

> I have made it a special point to examine rigidly all cows, and condemn such as one would feel justified in doing, under the present knowledge of the ill effects of the consumption of such flesh. I hope the time will come when all cases of tuberculosis may be condemned, for recent experiments with tuberculous beef prove that the flesh contains the bacillus as well as the pulmonary and glandular tissue. Again, even if it is confined in the glandular tissue, as some suppose, and the flesh perfectly healthy, the smaller glands are so distributed throughout the body that it would be impossible to dress the animal without still leaving some tuberculous glandular tissue.
>
> I have made it a point to condemn all animals showing lesions on the pleura and peritonæum, irrespective of the extent of the pulmonary lesions. This may seem mild to the profession, but when it is taken into consideration that all cannot be condemned, and that the above lesions, in the form of tubercles, lie next to the flesh and are eaten by the community as so much fat, it will be seen that it is a good basis to work on at the present time. Of course, animals with extensive pulmonary lesions are condemned, even though they show no lesions elsewhere.
>
> It has been suggested that tuberculous beef might have placed on it a tag, stamping it as such; but it will be seen that this would simply allow unscrupulous persons to buy it cheap, and impose it on the public in the form of mixed and canned meats.

Table V. — *Percentage of Tuberculosis among Cattle inspected.*

Class of Animals.	Number.	Tuberculosis.	
1. Whole number of all kinds, .	28,296	54	**0.19** per cent.
2. Cows from eastern States, .	1,153	52	**4.5** per cent.
3. Oxen, ...	–	1	–
4. Western cow, ...	–	1	–
5. Old cows sent to the dead-house, which have died in the city and its neighborhood, ...	116	12	**10.3** per cent

From the foregoing table it will be seen that only one western animal showed any lesions of tuberculosis, and this was a fine large heifer dressing 835 pounds. This animal was condemned. The above table presents features of very great interest to the people of Boston, for it shows a condition of the cattle that ought to receive prompt and careful attention. When the cattle of the United States are considered, the percentage of tuberculosis is found to be very small; when cows from the eastern States are examined, a more serious state of affairs is exposed; but when the condition of the old, unthrifty cows in the city and neighborhood is studied, and the class of people to whom their milk and other products are distributed are taken into account, the subject becomes a very serious one, and well worth the immediate attention of our health authorities. As a prevention of the above dangers, I should advise the examination of all milch herds in the city and State semi-annually, and the condemning of such as show lesions of tuberculosis. Though I am a firm believer in the contagiousness of and dangers from existing tuberculosis, I do not believe that it prevails to any such extent as some observers state. The statistics shown in Table V. are founded on facts and careful examinations, followed by a microscopic examination, for one year; and when last year's report is recalled, the two will be seen to compare favorably. I believe the per cent. stated in this table (that is, about 5 per cent.) to be sufficiently serious.

In closing, permit me to refer to the sensational articles on the prevalence of this disease in Massachusetts, from the pens of those who occupy conspicuous positions in the State where they reside. Professor Liautard, Dean of the Faculty of the American Veterinary College of New York, and editor of the "American Veterinary Review," on the authority of Dr. Bailey, State Veterinarian of Maine, and others of his friends, says in an editorial in the "Review" for December last, that from 35 to 50 per cent. of the cattle of Massachusetts are tuberculous.

Dr Bailey, State Veterinarian of Maine, endorses Dr. Liautard in a recent official paper, entirely ignoring official testimony on the subject. The following will show that Massachusetts is not an exception to any other State. Dr. Meichener, Inspector for New York City, reports 5,000 cows from about the city, as follows: 1,379 head of unthrifty animals from parts known to be tuberculous, 11 per cent; balance of the 5,000 at from 4 to 5 per cent. These, as will be seen, agree with my statistics.

Dr. Bryden estimates the percentage of tuberculous cows in Massachusetts at about 5 per cent; other cattle at about 2 per cent. He excepts old cows in the neighborhood of cities, which will show a larger percentage, according as they are closely weeded out or not.

Dr. Becket's views are similar to the above, and I believe their estimates to be correct.

Bradford.

The nuisances have been abated by the owners of property sometimes willingly, and sometimes unwillingly, but they have been abated. The board is unable to determine why a man should be reluctant to put into a condition safe for occupancy premises owned by him but rented to another party; still the fact remains that our most unpleasant work has been to compel some men to do what common decency and a regard for their fellow creatures of smaller means should have caused them to do without warning.

We would urge upon the townspeople this thought: You cannot be too careful in regard to the disposal of your sewage and the plumbing in your houses, and if you will receive the suggestions of this board in the kindly spirit in which they are given, a task disagreeable at best will be somewhat lightened.

There have been reported to the board during the year 24 cases of contagious or infectious disease as follows: —

Diphtheria, 13; scarlet-fever, 3; measles, 3; typhoid fever, 5. Of this number but 2 died: 1 from diphtheria and 1 from typhoid fever. The greatest care was taken by the board to investigate each case, placard the house, correct any sanitary defects and advise in regard to other disinfection. To-day there are 2 cases of contagious disease in town.

The work of the agent has been laborious and the compensation much too small.

BROCKTON.

During the year, 467 deaths were reported within the limits of our city, an increase from 1889 of 56.

With a population of 27,278, the death-rate for the year is 17.12 for every 1,000 of the population.

Contagious diseases reported during the year: diphtheria, 47; scarlet-fever, 13; scarlatina, 14; measles, 12; total, 86.

The need of a system of sewage disposal is too apparent to every one to require a single argument; but the satisfactory disposal of this large amount of waste matter of the city is a question that will bear the most thorough investigation.

Any plan that may be adopted must purify the sewage so that the effluent will do no harm when it finds its way into the neighboring streams, especially so if the streams are a source of domestic water supply.

CAMBRIDGE.

Special prominence is given in the report to certain offensive trades existing in the city limits, especially the slaughter house near Fresh Pond, another on Portland Street and the great slaughtering and rendering works in the border of East Cambridge and Somerville. The importance of conveying the sewage of the latter to the metropolitan sewer is emphasized.

The Eleventh Census of the United States places the population of Cambridge at 70,028.

The mortality for the year, based on these figures, was 17.05 per 1,000 persons living.

There were reported during the year 157 cases of diphtheria, a decrease of 194 cases from the previous year; 189 cases of scarlet-fever, an increase of 73 cases from the previous year; and 76 cases of typhoid-fever, a decrease of 124 cases from the previous year. Though the cases of typhoid fever have been few during 1890 we must not be lulled into content with any fancied security, but must strive for a regular, thorough inspection of our water supply from its sources to its final distribution. And this applies with peculiar force to Stony Brook and to the water-shed from which its tributaries arise.

In recent years a number of epidemics of typhoid fever have been traced to the milk supplied from farms where this disease existed. Last July the attention of the board was called to a milk dealer's place in Cambridge, where a case of typhoid fever existed. The patient was being nursed by a woman who was, in addition to her duties about the sick person, engaged in milking the cows and washing the cans. This dangerous combination occurring within their jurisdiction, the board was able to interfere and put a stop to such proceedings; but let such a case happen at one of the dairy farms outside of Cambridge (and who shall say it may not occur at any moment), and every one supplied with milk from this farm is in imminent danger. It is not enough for us to know that the most scrupulous cleanliness is exercised about everything that comes in contact with the milk. We should also have information whenever there is a case of typhoid fever at the farm from which the milk comes, and power to prohibit the sale of this milk in our city, unless such precautions are taken at the farm as the board may see fit to impose.

CANTON.

Seventy-two complaints for nuisance have been filed. On all of these cases abatements were immediately ordered and were, with one exception, promptly complied with. In this case we were informed by the party complained of that one of the selectmen advised him to let the nuisance remain, to wit, to allow a sink drain to run into the public highway.

The number of cases of infectious or contagious diseases were: scarlet-fever, 2; diphtheria, 5; typhoid fever, 5; membranous croup, 3; and measles, 217; total, 232. Deaths resulting therefrom, 3.

CHELSEA.

The number of deaths from diphtheria, scarlet-fever and typhoid fever is 29 per cent. less than in 1889, and 54 per cent. less than in 1888. This shows a marked decrease in two years in what are termed preventable diseases, and is, to a certain extent, an indication of the sanitary condition of the city.

We repeat, however, what we have taken occasion to say in substance in previous reports, that it should be kept constantly in mind that no city can maintain a fair sanitary condition except by the constant vigilance of its health authorities and the intelligent co-operation of all its citizens.

Thirty-two cases of diphtheria, 48 cases of scarlet-fever, 10 cases of typhoid fever and 1 case of small-pox have been reported to us during the year. We are quite sure that all the cases of typhoid fever have not been reported.

CHICOPEE.

The most noticeable event of the year is the largely increased mortality over preceding years. That this has not been due to any local cause is clearly manifest when we read the reports of other cities and towns. The epidemic of last winter, though not attended with marked mortality at the time, was very far-reaching in its final results. Many invalids and people with weakened vitality yielded to its influence. It was an especially potent factor in the production of pulmonary and bronchial affections, which greatly increased the mortality of the summer months. It respected neither age, sex nor previous condition of health. It knew no nationality; it showed no partiality.

Three hundred and forty-eight deaths were recorded in the town during the year 1890; or a ratio of 24.85 persons in 1,000, based upon a population of 14,000.

Zymotic Diseases. — Diphtheria, 9; diphtheria or membranous croup, 7; cerebro-spinal meningitis, 2; typhoid fever, 11; diarrhœa, 5; cholera infantum, 33; puerperal fever, 2; influenza, 2; erysipelas, 1; gangrene, 1; measles, 4.

CLINTON.

The following cases of dangerous diseases were reported to the board as occurring in town between February, 1890, and February, 1891: dysentery, 1; cerebro-spinal meningitis, 1; measles, 1; typhoid fever, 10; diphtheria, 12.

An epidemic of scarlet-fever prevailed during the whole year. Whole number of cases reported, 201. February, 4; March, 5; April, 2; May, 6; June, 5; July, 10; August, 22; September, 11; October, 28; November, 47; December, 30; January, 29; number of deaths, 6.

Cottage City.

I have but one case reported by the physicians of any contagious disease for the past year, this being an exception to all previous records.

The list of nuisances is larger than any previous year. This marked increase in the number of complaints received and investigated is not because nuisances are becoming more frequent, but for the reason that notice is now taken of the slightest sanitary defects.

Everett.

Four hundred and six complaints have received our attention during the past year, against 299 in the year 1889.

The importance of sewerage having been recognized by our citizens, the town, in compliance with their wishes, has begun and nearly completed its first system of sewerage.

Number cases scarlet-fever in 1890, 114, against 63 in 1889.
" " typhoid fever " " 9, " 35 " "
" " diphtheria " " 17, " 107 " "
" " measles " " 4, " 43 " "

When we consider our population of over 11,000 people with only 17 cases of diphtheria for the year, we feel justified in speaking in the highest terms of the improvement in the sanitary condition of our town. Most of the cases of scarlet-fever have been mild and of short duration.

The ratio of death from contagious diseases is very small in comparison with the number of deaths from other causes.

Fall River.

We have thirty-five and one-third miles of sewers and sixty-three miles of water pipe running underneath our streets. The large quantity of water pumped from the pond has to find its way to the river by the outlets of these sewers, or to remain in pools of filthy water soon to become stagnant and thereby circulate the germs of typhoid fever and diarrhœal diseases; therefore we feel that by increasing the number of outlets the amount of sickness and fatality from these causes will be correspondingly lessened.

If small-pox once secures a foothold in Fall River the mortality will be enormous; therefore we would impress upon the minds of parents the necessity of having their children properly vaccinated.

The clerk of the board of health has successfully vaccinated 914 applicants during the year.

The number of cases of contagious diseases reported to the board of health for the year 1890 was 407, against 633 for 1889.

The total number of deaths from the same diseases was 75, against 103 in 1889.

Diphtheria. — There were 87 cases reported and 26 deaths, against 42 cases reported and 15 deaths.

Scarlet-fever. — There were 56 cases reported and 2 deaths, against 185 cases reported and 34 deaths.

Typhoid fever. — There were 210 cases reported and 45 deaths, against 258 cases reported and 46 deaths.

Measles. — There were 54 cases reported and two deaths, against 148 cases and 46 deaths.

FITCHBURG.

All physicians are furnished with printed cards so arranged that the work of reporting is made easy. Upon the receipt of one of these cards by the chairman the facts contained thereon are recorded in a book especially provided for the purpose. The house where the sickness exists is visited by the agent, its sanitary arrangements and convenience for isolation investigated. Inquiry is made as to the probable source of contagion, the presence of existing cases in the neighborhood and the number of scholars in the family, with the schools they attend. Public library and school books in the family are taken and disinfected and returned to their respective places. In cases of scarlet-fever and diphtheria printed directions concerning isolation and disinfection are left with the family. The agent informs the superintendent of the schools of the name and residence of the patients and the different schools attended by the children of the family. Upon the termination of the case the premises are disinfected according to the printed instructions. If the case ends fatally the board requires the funeral to be private and the body to be conveyed in a hearse for burial. Such, in brief, is the routine pursued in a case of contagious disease.

The number of deaths from diseases which physicians are required to report to this board is given in the following table: —

	Cases Reported.	Died.
Scarlet-fever, ...	110	11
Diphtheria, ...	12	5
Croup, ...	2	2
Measles, ...	5	0
Typhoid fever, ...	19	4
Total, ...	148	22

FRANKLIN.

There have been reported to us seventeen cases of scarlet-fever, two of diphtheria and two of measles, in all of which due precautions were enjoined to prevent exposure. Nearly all the cases of scarlet-fever have been of a mild type, which, considering the number of cases and the various localities in which they occurred, plainly indicates — when taken in connection with the absence of other diseases frequently produced by local causes — that the general sanitary condition of the town has been good. But to maintain this desirable condition, especially in localities where our increasing population is already becoming dense, it is plain to us that some more effectual means of sewerage must be provided for the disposal of house drainage.

From investigations made we find a large number of children under six and seven years of age who have not been vaccinated, much to the danger of the community from an invasion of small-pox. In one primary school we found thirty-one scholars out of forty-two that had never been vaccinated, which leads us to think that over fifty per cent. of the children of the ages previously mentioned are in an unprotected condition.

GARDNER.

When we were chosen at the March meeting, we had reason to believe that the town would proceed with the adoption and building of a system of sewage disposal; but, at the same meeting, its rejection by a large majority, showed clearly that the scheme presented was not satisfactory to the voters. The board thereupon held a meeting, and, after full deliberation, decided that its plain duty was to thoroughly enlighten the citizens upon the serious condition of the more thickly populated parts of the town, resulting from the absence of the proper means for disposal of sewage and other waste, and, by assuming some authority, endeavor in public meeting, to have some plan agreed upon that would be reasonably free from the various objections made, and would successfully appeal to the town.

The plan proposed was heartily endorsed, and the town at the April meeting, accepted and adopted it, and chose the board of sewer commissioners.

At the close of the year, the North Main street sewer section is practically finished, and the main filter beds well under way.

Deaths from contagious diseases: diphtheria, 13; typhoid fever, 4; measles, 2; total, 19.

GLOUCESTER.

The city rejected the acceptance of a sewerage system at the recent election; this compels attention to a subject which is daily becoming more serious, namely: How shall we dispose of the contents of sink and privy vaults? It has been the custom to deposit them upon certain farm lands near the city; places of deposit becoming scarce the overseers of the poor consented, on certain conditions, not to object to our using a place upon the poor farm, near the Annisquam River, as a dumping-ground.

The day is soon coming when dumping-grounds near the city must cease to exist, and to judge from the complaints entered we think that day is almost here. What shall be done? If the city had voted for sewerage the problem would have been solved; this was not done and it only remains to suggest an expedient which would bear thorough investigation.

The general health of the city in 1890 was good as shown by the death-rate, and by other sources of information.

The number of cases of contagious diseases reported to the board was 157, viz.: scarlet-fever, 99; diphtheria, 42; typhoid fever, 16.

HAVERHILL.

The number of deaths during the year is 518, which is 100 more than in the preceding year, and 36 more than in 1888. The census population for 1890 is 27,322, giving a death-rate of 18.96. In 1889 the population of the city was estimated at 25,000, and the death-rate per 1,000 of the population was 16.61, or 2.35 less than last year. We had hoped to present, as in previous years, a considerably reduced death-rate, but the occurrence of epidemic influenza which began to manifest itself in the latter part of 1889, and the very great increase of humidity have frustrated these hopes. Although the fatality directly attributable to influenza is not large, yet a great part of the mortality from all the local diseases is undoubtedly due to its attendant complications.

Of the whole number of deaths those which are usually classed as zymotic numbered 118, or 22.78 per cent., which was 6.28 per cent. greater than that of 1889.

There were, during the year, 178 cases of contagious diseases reported to the board. Compared with 1889, diphtheria shows an increase of 69 cases and 22 deaths; typhoid fever an increase of 2 cases and 3 deaths, and measles a decrease of 288 cases reported and no deaths. Scarlet-fever, which for various reasons is the most difficult disease to control of any with which we have to contend, shows an increase of 15 cases and 5 deaths.

HOLYOKE.

The city has fortunately escaped during the past year the extensive prevalence of any of the infectious diseases.

Whooping-cough, which prevailed very extensively the preceding year, has almost disappeared during the past year. There have been, too, very few cases of measles. Scarlet-fever and diphtheria have appeared here and there during almost all the year, but at no time have there been very many cases nor many in the same locality. Typhoid fever has prevailed to some extent but not more so than ordinarily and it was of moderately severe type. We have been fortunate in escaping small-pox during the year, but while our hospital for this is always ready it were wise if more precautions were taken in the way of vaccination and thus forestall its spread in case of its appearance. The city has fortunately been spared the outbreak of a single case of small-pox during the past year.

Eternal vigilance, however, is the price of safety, and we cannot too strongly urge the necessity of general vaccination throughout the city as the only safeguard against this pestilent visitor.

It is now several years since a general vaccination of the city was made; a great number must have since become residents here who have never been vaccinated; the number of children since born here and as yet unprotected by vaccination must be very great, as well as the number of children coming here from other places where vaccination is not enforced; and therefore we deem it most urgent that means be provided us for the prosecution of this work early in the coming year.

The shifting character of a large part of our population and the importation from all quarters of the globe of rags for our paper mills are special reasons why Holyoke should take extraordinary precautions against small-pox.

HUDSON.

During the year 20 cases of diphtheria, 7 cases of scarlet-fever and 2 cases of measles have been reported to the board.

Recent scientific research has led to the belief that consumption is a contagious disease, common to both men and animals, and communicable by the use, as food, of the milk or flesh of tuberculous cattle. Owing to the great importance of the matter, as regards consumption and its communicability from animals to men, by the use of milk and flesh, it is hoped that all owners of cattle and others concerned, will exercise proper vigilance in respect to sick animals, by reporting to the board for inspection by competent persons, any suspected cases of disease, or cases not thoroughly understood, that there may be no risk of the spread of so dread a disease as consumption by causes that may be remedied.

Hyde Park.

The general health of the town has been good.

There has been no epidemic of diseases during the year.

Our citizens are giving greater attention to sanitary appliances and measures, and with beneficial results.

In all cases of diphtheria, typhoid fever and scarlet-fever reported to the board, placards have been displayed and the premises have been thoroughly disinfected by order of the board.

The number of contagious diseases reported to the board for the year 1890, has been as follows: —

Diphtheria,	60 cases with 21 deaths.
Scarlet-fever,	7 cases with 0 deaths.
Typhoid fever,	38 cases with 6 deaths.
Cynanche trachealis,	1 case with 1 death.
Measles,	4 cases with 0 deaths.

Lynn.

The board has given much of its time and attention to the enforcement of the statutes requiring the entrance of all estates bordering on a line of the public sewer, and the work performed by the inspectors in this direction has been most satisfactory, three hundred and seventy-five permits having been granted to enter the sewer within the year.

The whole number of sick cases reported to the board from the western district has been 201, with 7 from the hospital; 34 were typhoid fever, 107 scarlet-fever, 51 diphtheria and 16 were measles. Males 110; females 91.

The total number of deaths which occurred during the year 1890 was 947. With a population of 55,717 (national census) the death-rate would be 16.99, only .05 more than in 1889, notwithstanding the increased mortality caused by the epidemic of influenza during the months of January, February and March. The largest monthly mortality was in January, when the number of deaths reached 110. Of this number, pneumonia caused 34 and consumption 20. There were 488 deaths among males and 359 among females.

Number of Cases of Contagious Diseases reported, and Mortality.

	Reported.	Died.
Diphtheria,	130	34
Scarlet-fever,	176	5
Typhoid fever,	59	11

MALDEN.

During the past year there has been no unusual amount of sickness. Diseases of a contagious or infectious character have been of a mild type in most cases, and have not at any time threatened to become epidemic.

About one-half of the whole number of cases of diphtheria reported to the board have been within the limits of ward 6, and were largely in one small locality.

Number of contagious diseases reported during the year: diphtheria, 67; scarlet-fever, 67; measles, 35; typhoid fever, 30.

MAYNARD.

While we are pleased to note the great benefit derived from the introduction of a system of pure water into our town, we, on the other hand, must not lose sight of another important fact which has a decided bearing upon the public health.

The introduction of water works eventually increases the danger, unless accompanied by a system of sewerage. The example that nature affords us of supplying, with every artery that carries pure blood to the various organs of the body, a vein in which the impure blood returns, should be followed by every town or city when it introduces a system of water supply.

Of course the subject of sewerage for our town, at the present time, is out of the question, but until sewerage is established, particular attention must be paid to the construction and care of cesspools, vaults and out-houses.

There has been no epidemic of a fatal nature in our town during the year. Typhoid fever has prevailed, perhaps, to a greater degree than in former years.

MEDFORD.

The health work throughout the town is rapidly increasing, and each day it becomes more and more imperative that it be attended to properly and without delay.

At the time this board was organized the sanitary needs of the town were few and the statutes required little. To-day it is far different. The statutes bearing upon sanitary measures are constantly becoming enlarged as well as more exacting. The citizens, realizing the importance of public hygiene, expect a great deal more of the health officials than formerly.

In Medford there is the most urgent need of careful and faithful sanitary work.

Much attention should be given to the proper plumbing of dwellings, disposal of waste and filth, in the examination of cattle, and the inspection of milk and food supplies.

Nineteen cases of scarlet-fever have been reported. Of this number one case was fatal. This is the only death from this disease reported as occurring in the town for two years.

Typhoid fever has not prevailed to any extent since the summer of 1889. Last year 15 cases of this disease, with 1 death, were reported.

Measles have prevailed to some extent the past year, but a great many cases occur which are not attended by a physician, and thus are not reported. Much more care should be observed by parents in such cases.

Fifty-two cases of diphtheria have been reported. Of this number 5 were fatal. The board has endeavored to do all it could to prevent the spread of the disease, which is certainly increasing year by year. In the majority of cases the plumbing and sanitary arrangements were carefully inspected; and in all cases the premises were required to be thoroughly fumigated. The board still follows the custom established some years ago of requiring a placard to be placed upon the infected premises.

A statement relative to the occurrence of cases of contagious disease (tuberculosis and pleuro-pneumonia) among the cows at the establishment of Mr. R. A. Lane, a milk-producer doing business in Medford, appears in the report.

The extremely unfavorable conditions for the production of good and wholesome milk existing at this place were made the subject of comment in the report of the State Board of Health for 1883 (Supplement, page 103). It would appear that but little if any improvement has been made since that time.

MELROSE.

Over one hundred nuisances have been investigated by the board of health. These have consisted of defective sink drains, overflowing and offensive cesspools, filthy privy vaults, foul-smelling pig-pens, and premises where filth and rubbish had been allowed to collect and to become offensive to the neighborhood. One hundred notices have been served, and four second notices. In most instances personal suggestions have been willingly carried out, and in only two cases has the board been obliged to summon persons to court.

Many portions of Melrose, now becoming thickly settled, could well dispense with those unmitigated nuisances, the old-fashioned privy and the pig-pen, that, at least, one might sleep at night with open windows without the danger of breathing the offensive odors that arise from these sources.

The number of cases of contagious diseases reported to the board of health for the year was 65, as follows: diphtheria, 17; scarlet-fever, 36; typhoid fever, 10; measles, 1; membranous croup, 2.

Millbury.

In the month of July the attention of the board was called by the State Cattle Commissioners to a case of glanders in a horse in the outskirts of the town. Acting under the instructions of the Cattle Commissioners, we caused the diseased horse to be killed and safely buried, and the infected premises cleansed and disinfected. No extension of the disease occurred.

Eleven cases of diphtheria have been reported to the board during the year. No other contagious diseases have been reported.

The board believes it for the advantage of the town that its board should join the "Massachusetts Association of Boards of Health," whose objects, as stated in its constitution, are, "the advancement of sanitary science in the State of Massachusetts, the promotion of better organization and co-operation in the local boards of health, the uniform enforcement of sanitary laws and regulations;" and, since the board serves without pay, it seems right that any expense attendant upon membership should be met by the town.

The action of the town at the town meeting holden in January indicates that a board of health is regarded as a permanent institution.

Nahant.

The town has enjoyed another year of almost entire immunity from dangerous contagious diseases. But two cases were reported to the board, and in both of these the patients recovered.

A careful examination was made of all houses and sewer connections. In the more densely populated portion of the town, especially during the summer season, there has been an inspection of the houses and premises twice a month. In the whole town, fifty-one houses and seventy-five vaults were found in some way defective. The suggestions for improvement, made by the health officer, have been favorably received, our citizens realizing that the alterations recommended are for their own good as well as for the community in general.

NEEDHAM.

Of the contagious and infectious diseases, diphtheria, scarlet-fever, typhoid fever and measles prevailed to a slight extent during the year, but at no time did they become epidemic. While there has been no change in the relative number of cases of scarlet-fever from last year (many cases being reported as "scarlatina," but all being classed as scarlet-fever), the number of cases of typhoid fever has increased by two, and that of diphtheria one, which terminated fatally.

The following table will show the total number of these diseases reported for the year: —

Scarlet-fever,	20	Diphtheria,	1
Typhoid fever,	3		—
Measles,	2	Total,	26

As in previous years, the keeping of swine in the town is the chief source of complaint, and the board has found it necessary to perform the unpleasant duty of appealing to the court to abolish two piggeries after all other measures had failed, and unless other parties in the same employment use more care in conducting this branch of their business future boards will be obliged to pursue the same stringent measures to protect the public from this nuisance. For the farmer this pursuit is profitable, but to the growth of the town it is detrimental; the interest of both is mutual.

NORTH ADAMS.

During the past year the town has been unusually free from contagious diseases. The following table shows a comparison with the previous years: —

	1888-89.		1889-90.		1890-91.	
	Cases Reported.	Fatal.	Cases Reported.	Fatal.	Cases Reported.	Fatal.
Typhoid fever,	114	16	30	5	11	5
Scarlet-fever,	28	0	70	14	17	5
Diphtheria,	2	2	7	5	6	1

Nuisances ordered abated, 151.

The question of providing suitable sewers for the south part of the village, and particularly that part known as the "swamp," will doubtless come before the town at this annual meeting.

The deaths among the pupils in public schools have been greatly diminished, although at the same time the number of pupils has nearly doubled.

In the early years given in the table there were many cases of diphtheria and fevers, such as would be likely to result from overcrowding and bad ventilation. There are now very few of such cases.

NORTH ANDOVER.

There have been an unusual number of cases of diphtheria reported to the board during the past year. This same disease was very prevalent here in 1889, and the board would respectfully recommend that all drains from sinks, cesspools and vaults be carefully examined before the coming summer.

PLYMOUTH.

During the year 1890 there have been 19 deaths from consumption, and 4 from typhoid fever.

The number of cases of typhoid and scarlet-fever and diphtheria reported to the board for the year are as follows: typhoid fever, 17; scarlet-fever, 1; diphtheria, 2.

This shows an alarming increase in the number of cases of typhoid fever, and the board would call the attention of the inhabitants of the town to the fact that they cannot be too careful in regard to their sewerage; and also in drinking spring water to be sure that there is no sewer drainage near the spring, as the board feel confident that one death in the town during the year resulted from drinking water from a spring whose water was saturated with the drainage from a leaking sewer.

PROVINCETOWN.

We have been almost exempt from any of the contagious and infectious diseases which have prevailed so extensively in some parts of New England. A few cases of scarlet-fever were reported during the winter and spring, but they were of an unusually mild type, and as every precaution was taken to guard against its spread it did not prevail as an epidemic. Typhoid fever prevails more or less every year among the more crowded portions of our community.

It is a difficult matter for the sanitary laws to be fully observed where there is so much crowding together; especially is this the case where we have no system of sewerage, something that our town sorely needs, and which must come in the near future.

QUINCY.

Number of inspections made, 3,180. Nuisances discovered, 413. All but 12 were abated.

In the list occurs frequently the mention of an uncleaned cesspool or privy vault. This will be understood by bearing in mind that the custom is rapidly spreading of building houses in localities where the price of land is moderate, but where, from the swampy nature of the soil, it is impossible to secure a dry cellar or to thoroughly empty a cesspool. We therefore make the suggestion that in future the Commissioner of Public Works refuse permission to build whenever the character of the ground indicates that the intended dwelling will be unfit for habitation.

Cases of contagious diseases reported to the board: diphtheria, 67; scarlet-fever, 12; typhoid fever, 52; measles, 6. Deaths: diphtheria, 20; scarlet-fever, 1; typhoid fever, 7.

The cases of typhoid fever reported to the board, as well as those which have come under the treatment of the City Hospital staff, have been almost without exception among people who, either through prejudice, or from necessity, take their supply from a well. Diphtheria was also extremely prevalent, in some localities, constituting a veritable epidemic.

ROCKLAND.

During the past year but 6 cases of diphtheria have been reported, only 2 cases of typhoid fever, and 12 cases of scarlet-fever. Of the cases of diphtheria 3 were fatal; of the typhoid fever and scarlet-fever cases reported none were fatal, and most of those reported were of a mild type.

There were fewer complaints of nuisances than have been heretofore reported during a year. In almost every instance householders and property owners have co-operated with the board of health in rectifying and abolishing nuisances wherever they occurred.

SALEM.

There have been 125 cases of scarlet-fever this year against 106 last year. The type has generally been very mild, but two terminated fatally. There were 23 cases of diphtheria, 7 of which terminated fatally; and 44 cases of typhoid fever, 7 of them fatal.

SAUGUS.

There were reported to this board 14 cases of sickness from contagious diseases, of which 12 were diphtheria and 2 scarlet-fever.

The introduction of a public water supply increases very materially the amount of water used, and citizens must not forget that a larger use of water makes a corresponding increase in the amount of sewage to be taken care of, and although their cesspools have answered in the past, yet under the new conditions either more care and frequent emptying or an enlarged cesspool is necessary.

SHARON.

The death-rate for the year was considerably in excess of that of the previous year, the number reported having been 37 as compared with 27 for 1889, an increase of a little more than one-third.

To give a fair and impartial rendering of the unusually large death-rate for the past year, one must be advised as to the fact that a considerable number of the deaths registered (11) for 1890 were of foreign import, mostly invalids from other parts.

SOMERVILLE.

Scarlet-fever. — The year 1890 shows a slight decrease of the number of cases reported as compared with 1889, there being 192 cases reported in 1889, and but 161 cases in 1890. It has continued to be, as in 1889, of a comparatively mild type, there being but 5 deaths in 1890 and 7 in 1889.

Warning cards are placed on the houses, and the premises fumigated after the termination of the disease.

Diphtheria. — There have been 117 cases reported and 21 deaths during the year, as compared with 130 cases reported and 28 deaths in 1889.

We use warning cards and fumigation in dealing with this disease, the same as with scarlet-fever, and we also have the sanitary conditions of the premises investigated.

Typhoid-fever. — There has been a much less number of cases in 1890 than in 1889, but the disease has proved more fatal, there being 61 cases and 7 deaths in 1889, and 37 cases and 10 deaths in 1890.

We examine the sanitary condition of the premises, but do not use a warning card or fumigation.

SPRINGFIELD.

In spite of the severe epidemic of the grippe, which occurred at the beginning of the year, our death-rate has been but 19.42 per thousand of population, and deaths from contagious disease, excluding those from grippe, have been less frequent than in preceding years.

Diphtheria and croup, which last year caused the deaths of 89 persons, have this year claimed but 44; there were 118 cases reported to the board of health against 213 in the preceding year. But 25 of these 213 cases occurred in the latter half of the year, and at the time of writing this report there is no case known to exist in the city.

Scarlet-fever has been more frequent than in 1889, but is generally very mild, only 7 deaths resulting from it.

There have been many cases of measles about the city, but the custom of reporting the disease is not yet well established, and it is impossible to say to what extent it has prevailed. There were 6 deaths reported.

Erysipelas caused 1 death; typhoid fever, 14; septic diseases, 10; and tuberculosis, 125. This last disease is at present receiving much attention from the physicians and sanitarians, and at some time it will be considered a part of the duty of boards of health to undertake its control. It has already been shown that it is, in a sense, contagious; that the contagion exists in the sputum of consumptives, and that such sputum ought to be carefully destroyed.

STONEHAM.

It is seldom that a case of contagious disease is reported. The record of the year shows 5 cases of diphtheria, 11 cases of scarlet-fever, 1 of typhoid fever.

The prompt attention of the board has been given in each case reported, and where remedies could be applied they have been quickly adopted.

SWAMPSCOTT.

During the year we have received and investigated all complaints brought to our notice, and have received 10 official notices of contagious diseases, consisting of 8 cases of scarlet-fever, 1 of diphtheria, and 1 of typhoid fever, which proved fatal. There has been only one death from contagious diseases this last year, and the general health of the town has been good.

TAUNTON.

The failure of the sewer project has left our city still behind in the march of improvement, and leaves a heavy responsibility upon the health department, which it can meet only in a partial degree. In many places the existing conditions must remain as they are until we can obtain an efficient system of sewerage.

The board has succeeded in having a complete overturn in the matter of the collection of night-soil, and the contents of cesspools. Three odorless excavators are now in use, entirely superseding the old box method. The work is now all done in the daytime, and without offensive odor, and in a much shorter time. By this method cleanliness, inoffensiveness and entire removal are secured, with safety and inodorousness of carriage.

WALTHAM.

The few cases of contagious disease reported to the board have been light, with one exception, and have not spread beyond the families in which they first appeared.

One case of bovine tuberculosis came to our notice, and one cow in the same herd in which it occurred was bought by private funds, killed, and found diseased. One other cow was quarantined and the disease does not seem to have extended.

The regulations of the board have been carefully revised this year, the plumbing and drainage specifications amplified, and the whole published in more convenient form.

The board of health should lead, not follow, public opinion on sanitary subjects.

To protect the people as far as possible against the losses and dangers attending the use of milk or provisions in any way infected or debased, we recommend that the clerk of the board of health be appointed inspector of milk, also of provisions and animals intended for slaughter, after adoption of chapter 58, Public Statutes.

We propose to make some provision before hot weather whereby sterilized milk shall be on sale under the guaranty of the board. We hope to perfect such arrangements with the health boards of neighboring towns that no dealer shall be allowed to sell milk in this city without furnishing satisfactory proof that his cattle and his premises are in good sanitary condition.

We are looking forward with much pleasure to the completion and general use of our system of sewerage. The cesspool must go, and may the privy vault not linger long after it. But our joy in contemplating this consummation is somewhat subdued by the consideration that the expense of the blessing will press severely on some, and that many will resist its application to themselves.

We believe that the time has come when some public action should be taken respecting the dog nuisance. We unhesitatingly take the ground that no one has the right to turn dogs, more than other animals, loose on the streets.

Recommendations.

Setting off parks and play grounds.

Rapid extension of concrete sidewalks.

Watering the streets eight or nine months of the year wherever the citizens will co-operate to the extent of paying one-half the cost.

Removing and renovating the pest-house.

Placing the collection of ashes again in the hands of this board.

Adoption by the city of the provisions of chapter 58, Public Statutes (relating to inspectors of meat, etc.).

Appointing the agent of the board of health inspector of milk.

Appointing the agent of the board of health inspector of meat, provisions, animals intended for slaughter, etc.

The adoption of the provisions of chapter 74 of the Acts of 1890 (relating to privy vaults on sewered streets).

The adoption of an ordinance requiring that all dogs owned in the city shall be prevented from running at large.

Contagious diseases reported to the board of health in 1890: diphtheria, 8; typhoid fever, 27; scarlet-fever, 16; total, 51.

WARE.

During the past year there has been less disease of a contagious character in town than in many of the preceding years. The whole number of cases reported is 35, classed as follows: 2 cases of diphtheria, 5 cases of typhoid fever and 28 cases of scarlet-fever. Of the 28 cases of scarlet-fever but one proved fatal. This is a remarkably low percentage of deaths for that disease. Both cases of diphtheria died.

A large number of cases of chicken pox occurred in the vicinity of North and Vigeant streets, and many of the children were absent from school with it, but on account of the benign character of the disease the schools were not closed.

We have had our attention called again to the nuisance caused by keeping swine within the limits of the fire district. The board of health regulations say, "No swine shall be kept within the limits of the fire district unless the pens are kept thoroughly dry and regularly disinfected;" and as this practically means that no swine shall be kept within the village limits at all, especially in summer time, it would be well for all persons having any to dispose of them before the hot weather comes on.

WESTFIELD.

During the year 37 cases of contagious diseases were reported: 15 of diphtheria, 9 of scarlet-fever, 7 of measles, 4 of scarlatina, 2 of typhoid fever. In each family in which these cases existed the strictest quarantine was insisted upon. In one family, in which were four cases of scarlet-fever, the disease was confined to that family, and no scarlet-fever since reported.

WOBURN.

During the year physicians reported 19 cases of diphtheria, 33 of scarlet-fever, and 23 of typhoid fever, of which cases 4 of typhoid fever and one each of diphtheria and scarlet-fever were fatal.

WORCESTER.

Infectious Diseases reported to the Board of Health.

	Number of Cases.	Number of Deaths.	Death-rate per Cent.
Diphtheria,	115	20	17.39
Scarlet-fever,	100	6	6.00
Typhoid fever,	94	15	15.95
Measles,	158	1	.63

Of the various methods for the disposal of garbage it seems that some form of burning or treatment by heat offers the greatest advantage. Such disposition of our filth is surely sanitary and effective, and according to the best authorities the most economical method possible for an inland city.

Garbage and house offal are of but little value as fertilizers, and if used at all are in the best form after they have been through one of the modern furnaces and all dried and ground to a fine powder.

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